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ADAMANTINOMA OF THE LOWER JAW

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FROM THE SURGICAL SERVICE OF THE CINCINNATI GENERAL HOSPITAL

ADAMANTINOMA is said to be a rare tumor, but it is likely that many cases are not correctly diagnosed and are confused with sarcoma, carcinoma and epulis. Murphy[1] in 1924 collected 100 cases. In recent years several articles have appeared on this subject containing the report of a few cases. Simmons[2] in 1928 reported twelve cases of his own. In the past five years I have operated upon three cases and am reporting them chiefly because of their unusual size.

FIG. 1.—Case I.

FIG. 2.—Case I.

CASE I.—B. D., female, aged thirty-eight, K-4620. Admitted to the Cincinnati General Hospital, June, 1925. Eleven years before admission the patient noticed a lump on the right side of the lower jaw near the point of the chin. This appeared following the extraction of a tooth and increased slowly in size until the patient was admitted to the hospital. There was little pain connected with the tumor but the deformity was considerable and there was some difficulty in speech and deglutition. On admission the temperature was normal, pulse 100°, white blood cells 8,000, red blood cells 3,500,000, hæmoglobin 60 per cent. The patient's general condition was good except for the anæmia. Upon examination a huge tumor was found at the point of the jaw hanging down onto the chest wall and extending almost from one angle of the jaw to the other (Figs. 1 and 2). The greater portion of the tumor was soft and fluctuant although a thin shell of bone could be made out over the portion of it nearest the mandible. X-rays showed that the mandible was almost entirely destroyed save for a rim of

bone posteriorly. A blood transfusion was given the day before operation, which was done in June, 1925. At operation the tumor was exposed by reflecting the soft tissues from it, rongeuring away a thin shell of bone at the angle of the jaw, and peeling the tumor out of its bony bed. This was readily done as there was a very definite

FIG. 3.—Case I. Showing local recurrences after conservative removal.

FIG. 4.—Case I. Showing end-result after radical resection of jaw.

cleavage plane. The tumor was slightly torn at one point. The patient was fed with a nasal tube for two weeks. The convalescence was complicated by an osteomyelitis of the jaw which readily cleared up following the extrusion of a sequestrum. The patient remained well until January, 1927, eighteen months after the first operation.

FIG. 5.—Case II.

FIG. 6.—Case II. Note the infected sloughing areas.

At that time she returned to the hospital with several large and small recurrences in the bone and in the soft tissues. A second operation was done and the jaw resected from angle to angle. She has remained well (Figs. 3 and 4).

Pathology.—The tumor was found to contain many cyst-like areas of varying size, some being as large as 7 centimetres in diameter. These cysts as a rule contained

yellowish, gelatinous material; some contained mucoid, clear fluid. There were many solid areas in the tumor. The tumor mass was encapsulated everywhere except at one point where it had been torn. The solid tissue in the tumor was, for the most part, soft and friable. There seemed to be a good deal of connective tissue throughout the tumor.

The microscopic sections showed "a uniformity typical adamantinoma with the plexiform type predominating. Most of the "enamel organs" are typically constructed: an outer, peripheral layer of ameloblasts abutting on a loose stroma, with a central area of pulp cells, mostly polygonal and anastomotic, forming a dense plexus. Here and there these pulp cells have escaped from the confines of the ameloblasts and are growing in more frankly epithelial sheets approximating the acanthomatous type of adamantinoma." (Dr. N. C. Foot.)

CASE II.—B. B., female, aged forty-eight, L-3581. Admitted to the Cincinnati General Hospital April, 1926. Twelve years before admission, following the removal of a wisdom tooth, a small tumor appeared in the right side of the mandible near the angle. This gradually increased in size and was not accompanied by pain. Two unsuccessful attempts at removal were made, one in 1915 and another in 1917. Following

FIG. 7.—Case II. Two weeks after operation.

FIG. 8.—X-ray of Case II.

the second operation the tumor reappeared very rapidly. The tumor mass ulcerated about one year before admission, the patient having had several severe hæmorrhages from it, and numerous small ones. On admission the temperature was 98°, pulse 120, white blood cells 19,600, red blood cells 3,000,000, hæmoglobin 50 per cent. The patient's general condition was extremely poor. She was emaciated, weak and extremely anæmic. She had been unable to chew her food and could take only small amounts of water. She presented a huge tumor (Figs. 5 and 6) extending from the lower left canine around to the temporo-mandibular joint on the right, and from the temporal fossa to the carotid triangle. The tumor was of such size that it had displaced the nose and right eye toward the left. The tumor was ulcerated in many places and very badly infected. The teeth were widely separated where they were involved in the tumor. The jaw was expanded to paper-like thinness over portions of the tumor, being absent over others, where one could feel a soft tumor mass. A blood transfusion was given the day before operation. The operation was done May 8, 1926, under intratracheal ether anæsthesia. A temporary ligation of the common carotid

artery on the right side was done with a piece of tape. The wound was left open until the completion of the operation when the constricting band was removed and the wound closed. At operation the soft tissues were reflected off the tumor, the ulcerated skin areas being left attached to the tumor mass. The jaw was sawed through to the left of the middle line, and the tumor-bearing area swung out and the jaw disarticulated at the temporo-mandibular joint. There was practically no arterial bleeding owing to the ligation of the common carotid, but there were huge veins which entered the tumor from the region of the antrum and the temporal fossa. The wound was closed without drainage. A second transfusion was given while the patient was on the operating table at the close of the operation. Following the operation the patient was fed with a nasal tube for several weeks until she could swallow and chew her food satisfactorily. An uneventful recovery ensued. The patient has remained well to date (Fig. 7).

Pathology.—On section the tumor was found to consist of many cysts filled with gelatinous material. The bone was practically entirely destroyed. There were many areas of solid cellular tumor interposed among the cysts. There were many hard, bony-

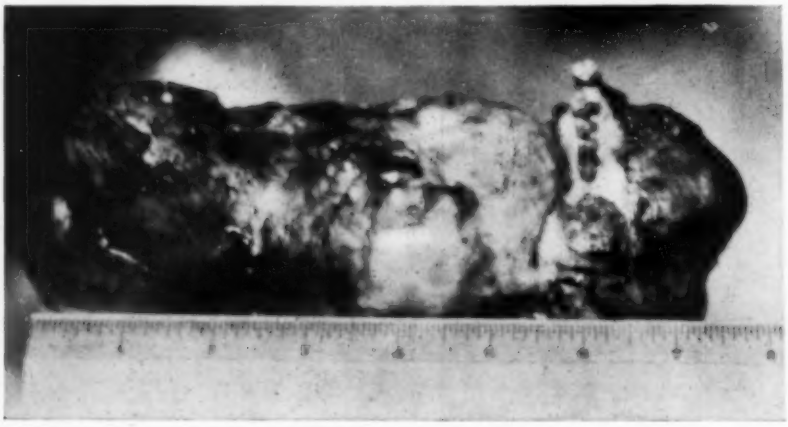

FIG. 9.—The tumor in Case II.

like areas in the tumor. The microscopic sections showed an example of all of the types of cells described in adamantinoma (Figs. 8 and 9).

CASE III.—J. W., female, aged thirty-one, M-7906. Admitted to the Cincinnati General Hospital, August, 1927. Twelve years before admission a lump was noticed in the right lower jaw following the removal of a tooth. The tumor grew steadily and slowly until two years before admission when it began to grow larger rapidly, and to cause a great deal of pain. Six months before admission the tumor mass was incised by the family physician. Some thin, bloody fluid escaped. From then on until her admission to the Cincinnati General Hospital a few months later she lost considerable weight and strength owing to her inability to masticate her food. When admitted to the hospital her temperature was 99°, pulse 100, white blood cells 8,000, red blood cells, 4,000,000, hæmoglobin 90 per cent. The patient's general condition was good. She presented a tumor mass occupying the mandible from the temporal mandibular joint to the point of the chin. This mass extended well into the mouth where it had separated the teeth widely and had thinned the bone out to a very thin sheet over most of the tumor on its lateral aspect. Ping-pong ball crepitus could be made out over most of the tumor. There were a few soft, cystic areas. Operation was done August 30, 1927. A ligation of the external carotid artery was done as a preliminary. The jaw was sawed through with a Gigli saw just medial to the left second incisor. The tumor mass and jaw were swung laterally and disarticulation of the temporo-

mandibular joint done. The patient was fed through a nasal tube for a few weeks after operation. Her recovery was uneventful and she has remained well since.

Pathology.—The tumor had expanded the mandible to a very thin shell everywhere and in places the bone was missing. On section the tumor was found to consist of cystic and solid areas. There was a great deal of fibrous tissue present. The cyst contained a glairy, yellowish material. The solid portion of the tumor was very cellular. The microscopic examination showed a typical adamantinoma (Figs. 10 and 11).

The classical work on the origin of adamantinoma is that of Melassez, published in 1885. He believed that this tumor arises from paradental epithelial débris, which consists of groups of cells scattered along the tooth from apex to gum margin. These cell groups he stated were not accidental offshoots but analogues of the rich dental apparatus found in the lower vertebrates which give rise to the supernumerary teeth of the so-called third dentition. All these groups, *viz.*, the *superficial*, which lie just beneath the

FIG. 10.—Case III.

FIG. 11.—X-ray of Case III. Note the cystic areas in the middle.

mucous membrane of the gum; the *intermediate*, found at the side of the tooth; and the *deep*, which are connected with the enamel organ, are formed from invaginations of gingival epithelium which go to form the enamel organ. Hence the tumor may show one or all of the cell types found in the transition from squamous cells to enameloblasts. The microscopic picture will vary, depending on the degree of differentiation of the cells. Thus we may find sheets of prickle cells resembling squamous-cell carcinoma, areas with glandular arrangement suggesting adenoma or areas presenting masses of stellate enamel cells. Any or all three of these types may be found in the same tumor. There is a heavy, connective-tissue stroma which may in certain portions of the tumor predominate and suggest sarcoma.

Most of the tumors in the lower jaw are cystic in contrast with those

in the upper jaw, which are more often solid, and consequently are more malignant and of more serious prognosis. The tumors are found within the alveolar borders of the jaw and expand the bone to parchment-like thinness as they enlarge, giving rise to the ping-pong ball crepitus so often elicited. The tumor may break through the bone and extend into neighboring structures.

Adamantinoma occur chiefly in adults and many are found in patients from sixty to seventy years of age. Our tumors were all in women, which is in accord with the fact that they are more often affected than men. It is of interest to note that in each case there was a history of the tumor beginning after the extraction of a tooth. Trauma or infection, and continued irritation, are supposed to produce the stimulus to the paradental epithelial débris necessary to start the growth, and thus produce the tumor. The tumors grow slowly. Two of our cases showed a duration of twelve years and one of eleven. There was no metastasis in our series. This type of tumor rarely metastasizes. Ewing[3] has seen metastasis twice to the cervical glands. Of Simmons[2] twelve cases two showed late metastasis to the cervical glands.

All three of our cases had had one or more conservative operations followed by local recurrences, and with each recurrence the tumor reappeared more promptly and grew more rapidly. Simmons[2] found that in ten of his twelve cases recurrences followed local removal. We have practised and advised radical resection of the jaw. All of our cases have remained well following such a procedure. New[4] reports one case treated by surgical diathermy with local recurrence in three months but on second destruction by diathermy the tumor has not reappeared for two years. Preliminary ligation of the external carotid in one case and temporary occlusion of the common carotid in another considerably facilitated the removal of two of the huge tumors in my series. Feeding with a nasal tube during convalescence was practiced in all three cases and transfusions were used twice in the debilitated and anæmic patients.

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PRIMARY STAPHYLOCOCCUS INFECTIONS OF THE NOSE, LIPS AND FACE

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There are few clinical and scientific entities in the practice of medicine, especially in the field of surgery, that present such a dramatic and concise clinical picture, with a high mortality rate, after comparatively short illness, as primary infections of the nose, lips and face, due to the *staphylococcus aureus*. Since 1852,[1] cases of infection of this type have been reported and from time to time contributions to the literature have been made, discussing the clinical, therapeutic, pathologic and scientific aspects of this condition. There is a general agreement as to the causative organism and the pathologic findings, but the opinion as to the proper treatment is still debatable.

From 1922, eighteen cases of primary infection of the nose, lips and face were admitted to the wards of Lebanon Hospital—of these cases, six were severe and the others were of the extremely mild type, with one exception, which had a temperature of 103°F. for one day (the reason for admitting these mild cases to be discussed). The youngest patient was twelve years of age, and the oldest seventy-one—the greatest percentage was between the ages of forty to fifty. Of this group, twelve were males and six females. Of the six patients with severe symptoms who died, four were males and two females, varying from twenty-four to fifty years of age. The duration of the illness was from four to twenty days. In all six there was a positive *staphylococcus aureus* blood culture, with the subsequent cultures becoming progressively worse, with thrombosis of the cavernous sinus terminating in death. The cavernous sinus was involved on one side in two cases, bilateral in 2, meningitis in 1, septicæmia (only) in 2 others, and of this group 1 had a cellulitis of the face, and another cellulitis of the nose.

The history of these cases started with a definite history as to injury—picking, scratch, abrasion, contusion, *etc.*, or the spontaneous appearance of a "pimple," which either subsided, or was disturbed by trauma (squeezing or cutting) or continued with increasing severity. The patient was usually admitted to the hospital complaining of swelling of the particular part, pain in the local area, shooting pain in the head, chills and fever, or was admitted in a comatose state. Examination usually showed the signs of inflammation of the part with the adjacent œdematous appearance of the face, eyelids, forehead or lips. Chemosis, marked exophthalmas with congestion of the orbit, choked disc and retinal hæmorrhages or coma were seen. None however, showed hyperesthesia of the first division of the fifth nerve, or paralysis of the third or sixth nerves. Only one patient presented findings of bronchopneumonia which was of the pneumonic type 3—no signs of metastatic abscesses were

found in our series. It is of interest to note that only two of the mild cases had a history of diabetes, and one of these syphilis. No other chronic ailments were present. Two of the fatal cases had an incision and drainage done, with very little pus found. No ligations of the facial veins were done. I desire to emphasize the fact that in the Lebanon Hospital series no case of primary *staphylococcus-aureus* infection of the face, lips or nose was present in any patient below the age of twelve years. Hudson[2] reported a fatality in a patient of fourteen years of age. Incidentally, a number of surgeons, pathologists, pædiatricians, and medical men were questioned relative to the latter, and none recalled having seen a case below the age of twelve years.

The suddenness of the appearance of this condition, the rapid progress of the symptoms, the high mortality rate, the frequency of this condition from adolescence onward and the fact that healthy, well-nourished individuals are prone to this infection, with dramatic termination of life, makes this subject an important one. Dr. Walton Martin[3] asked the following questions: (*a*) What is the interpretation of this particular gravity of infection by similar organisms in certain cases? (*b*) Why had he five deaths only among eighty carbuncles of the neck and back, many among the old people, enfeebled, the diabetic, and seven deaths in carbuncle of the lip in persons all below forty-five years old? (*c*) Why had death followed promptly on admission? These questions have been present in the minds of many, and it becomes necessary to examine all the known factors in this condition.

Anatomy and Physiology.—In proceding with this phase, we must consider the skin, and the venous system from the anatomic as well as the physiologic view in order to appreciate what nature contributes to the gravity of the condition in question.

The skin of the face is unusually thin for protective covering of so important an area and is exceeded in thinness only by the skin of the eyelids and prepuce.[4] As a result of this peculiar anatomic characteristic, it is interwoven with the underlying structures, as the muscle fibres, blood-vessels, lymphatics, and the unusual small amount of subcutaneous tissue. The skin in this area is extremely vascular, rich in glands and hair follicles. It is obvious that such important structures as the veins become here apparently superficial, more so than any localized important venous vessel or vessels elsewhere in the body. One of the main functions of the skin is its protective mechanism. The skin is so often the subject of staphylococcus infection for the following reasons: (*a*) The epidermal invaginations—the piliary follicles allow the entrance of and harboring of dirt and organisms. (*b*) It appears that the staphylococcus finds its natural home in the follicles, and it appears too, to have a special affinity for the skin, just as *Bacillus dysenteri* has for the large bowel.[5]

The skin has some muscle fibres attached to its lowest layer and there is little connecting or subcutaneous tissue present. This is an important fact for the allowance of distention produced by any inflammatory material between the skin and the underlying structures. The main substance of the lips is made up of connective tissue and muscle fibres. There are nine muscles, one of which is a true sphincter. The orbicularis oris and the other eight are bilaterally placed, converging toward the sphincter, giving rise to a network of muscle fibres whose function is like the muscles of the extremities,[6] hence, when the lips are moving, the muscle fibres are constricting the blood content, and thus assist in accelerating the blood flow into the general circulation.

The venous network of the face, lips, nose and cavernous sinus are united through a moderately complicated structure of superficial veins. The facial vein, which is the

continuation of the angular vein, starting from the medial commisure of the eye, receives two tributaries at its origin: the supra-orbital and the frontal veins. It proceeds downward and posteriorly, and as it descends it receives tributaries from the nose, lips and facial areas. It communicates, through the angular vein superiorly, with the superior ophthalmic vein, which in turn extends posteriorly through the supra-orbital fissure to the origin of the cavernous sinus. Inferiorly, the facial vein communicates with the cavernous sinus through the deep facial vein, which enters the pterygoid plexus and communicates with the cavernous sinus through the foramen ovale. The inferior ophthalmic, which also enters into the formation of the cavernous sinus, communicates with pterygoid plexus through the infra-orbital fissue. The nasal veins either enter into the superior ophthalmic or the tributaries of the facial.

If a figure is drawn roughly as follows: A vertical line through the root and tip of the nose, and from each side, extending laterally, from the superior ciliary ridge above, and from the lower border of the chin below, united by a vertical line drawn just lateral to the outer border of the orbit, one will find all the important network of veins, as described above, communicating freely with each other and with the cavernous sinus. This rough rectangular figure can readily be designated as the danger area.

The facial vein, because of its extreme importance, has several natural anatomic characteristics which add to the gravity of the disease. It is a patent vein, not flaccid. Besides, it has no valves and therefore on being divided it remains open. When infected, it does not collapse as other veins do. The failure to collapse and thus obliterate the lumen and stop the spread of infection favors absorption and offers little resistance to the infection.[7] It is also of importance to state that injections either from the cerebral sinus or the jugular will enter the facial vein with the same ease.

There are no lymphatic vessels in the skull or in the eyeball.[8] The lymph from the skull passes along the adventitia of the cerebral blood-vessels to the meningeal lymphatics, which enter into the external lymphatics of the scalp. The frontal and anterior temporal vessels receive the lymph from the corresponding brain areas, and drain into the anterior auricular glands. The lymphatic vessels of the face, lips and nose enter into their respective glands but none drain into the anterior auricular glands. Therefore, there is no communication between the lymph of the skull and that of the face, lips or nose. The lymphatic vessels of the nasal fossæ can be injected from the subdural and subarachnoid space,[9] but apparently there is no flow of lymph in either direction. Since the lymphatics are all provided with valves,[10] the effect of external pressure on them is to cause the lymph to flow in one direction, namely, toward the thoracic duct and great veins, and never in a retrograde direction.

In summarizing the above, we can state that the skin, with its rich vascular system, its thinness, its close relationship with the dependent important venous and lymphatic structures, brings the important structures near to the external world and in turn brings the cavernous sinus but a short distance from the exterior surface. The anatomic chaacteristics of the facial vein favor the infection's spread in either direction.

The cerebral sinus and its physiologic venous flow in no way offer any assistance to the spread of infection.

Bacteriology and Immunology.—The large majority of acute and subacute purulent processes are by the members of a well-defined group of bacteria spoken of as a pyogenic cocci.[11] Among these preëminent in importance are the staphylococci. The group is made up of several members, but by far the most important, pathologically, is the *staphylococcus pyogenes aureus*, and is the most frequent cause of abscess, boils, and many other surgical conditions, such as acute circumscribed suppurative inflammations. The organism's natural affinity is for the skin.[12] It is always present on the external surface. It

is resistant to heat, cold, chemicals and can survive for weeks in dried pus. Its pathogenicity in man is evident as the simple rubbing of the organisms into the surface of unbroken skin, and will give rise to a boil and the introduction of a few cocci from a septic case into a wound may lead to a fatal pyæmia.[13] It is, however, characteristic in its ability to produce pyæmia, as well as an acute localized suppuration, especially in connection with skin and subcutaneous tissue, and from here spread and localize itself in independent tissues of the body.[14]

Immunity to staphlycocci is not present in the blood as a rule. Immunity to a definite strain may be developed when the individual has been previously infected, as in multiple furunculosis, or by the use of a vaccine. It is a known fact that the body at times is unable to produce sufficient antibodies to ward off a localized or general infection. In many instances, there will be just sufficient antibodies, as well as a cellular résponse, to localize and hold an infection to its entrance point, but while this is taking place, the organisms are still alive, and growing; but often with slight trauma such as cutting, squeezing, *etc.*, the bacteria enter the circulation and spread throughout the body. Severity of infection depends upon the following: (*a*) Resistance of the host; (*b*) virulence of the organism and quantity; (*c*) susceptibility, and (*d*) the specific responses of the body.[15]

Pathologic Physiology.—A young man notices a small pimple on his cheek (nose or lips), probably the result of a scratch, contusion or cut. The adjacent skin area is swollen and painful, as result of the inflammatory distention. Three or four days pass, the pimple has increased in size, the lower eyelid is beginning to swell, the face is swollen, the infected area is larger and appears to be "ripe" to the layman. He squeezes and expresses a little pus. A day or two later the condition either improves or the face becomes more painful, the eyelids more œdematous, the inflammation appears angry-looking, shooting pains in the head and severe headaches and fever. The mechanical pressure during the process of squeezing broke down nature's barrier of defense—the indurated circumscribed granulation tissue—and the organisms which were in the localized area, gradually increasing in virulence spread, producing a phlegmon. The facial vein becomes involved and a phlebitis follows. The primary focus (hair follicle) at this time extends through the skin layers to a circumscribed area of inflammation which is in the underlying tissue and important venous structures, and thus communicate directly with a vein or its branches. The result may be (*a*) a localized thrombophlebitis of the facial vein or (*b*) a minute erosion of the vessel communicating with the phlegmon. The facial vein, because of its patency and absence of valves, allows the inflammation to spread without any resistance in either direction, namely, upward toward the superior ophthalmic which enters the cavernous sinus, or downward to the deep facial which enters the pterygoid plexuses, and on to the cavernous sinus. The first direction is retrograde and the commonest form of spreading of this infection. At this stage the bacteria may enter the blood-stream either (*a*) through the minute erosion of the blood-vessel, or (*b*) due to a thrombus. The supply of bacteria to the circulation gives rise to a septicæmia with or without metastatic abscesses in other organs. The formed thrombus may (*a*) enlarge and extend through the entire length of the facial vein, thus obliterating the lumen of the vessel; (*b*)

extend into the superior ophthalmic vein and into the cavernous sinus; or (*c*) break and give rise to a septic embolus which lodges at the origin of the cavernous sinus and grows into an extensive thrombosis, which may also extend to the opposite side, and give rise to a bilateral cavernous sinus thrombosis. From the involved cavernous sinus by direct extension, the meninges become involved.

The original pathology has progressed to the point where there is a thrombosis which is infected—a constant source of supply and growth of bacteria to the blood-stream. This thrombosis may appear in from two to twenty days, depending upon the virulence and amount of the organism, and the resistance of the host, or his ability to maintain his resistance. With the constant supply of bacteria, the severity of the symptoms increases and after a few days the patient dies, either because of an intervening infection such as pneumonia (not metastatic) or due to the primary infection (furuncle, carbuncle or phlegmon) of the face (lips or nose) and a blood-stream infection (*a*) with or without metastatic abscesses in different organs, (*b*) thrombosis of the facial vein with or without the involvement of the cavernous sinus on one or both sides, or (*c*) meningitis with either of the above. Death is due to the toxicity of the infecting organism and the interference with the cranial circulation.

Discussion.—The fact that so many infections from *staphylococcus aureus* do occur elsewhere in the body with a comparatively low mortality rate marks this particular entity from the others, because it is so often a severe or a fatal condition. It is a definite known fact that the young, well-nourished healthy persons in the prime of life succumb to infections about the nose, lips and face while the old, enfeebled and chronically sick harbor infections in various other locations with a far smaller percentage of death. In the young and middle-aged, resistance is variable, mostly during the prime of life, for it is at this period that one is so active, and exposed to numerous factors, such as overwork, lack of sleep, injuries, *etc.*, which tend to decrease one's resistance. Important therefore, is the host's resistance, and the ability to maintain this resistance by proper care and attention. The majority of the former class will refuse to go to bed or stay at home and attend to this infection. The result is the encouragement of the infection, which, superimposed as it is upon the enumerated anatomic bases, readily gives rise to the fatality of this condition.

A question that presents itself for consideration is the possibility of the removal of the focus of infection. In cases of lateral sinus thrombosis, the result of fourteen cases revealed two deaths. In addition to the strong anatomic barriers, the reason for this is obvious. The patient is at rest, being under the treatment for the primary infection and at the presence of any complication (thrombosis), the surgical approach to the secondary condition (infected sinus) is simple. The removal of the focus of bacterial supply is eliminated. Park and Williams[16] state that "as a rule, the body can eliminate

the organism (staphylococcus) with surprising ease, if the primary source of infection is removed."

At the Lebanon Hospital, in thirty-four cases of infection of the neck, there was only one death, while in Doctor Martin's series of eighty infections of the neck, there were five deaths. In these two series, there were a fair number of the old, chronically ill, and feeble patients. The reason for the lower mortality in infections of the neck is the fact that the skin of the back of the neck is very thick, subcutaneous tissue is excessive and presents a greater barrier to the spread of the infection, and when it reaches the subcutaneous layer, the venous vessels are not as numerous and do not drain into or communicate with an important structure such as the cavernous sinus. However, death may occur with infections of the neck due to the virulence of the invading organisms and the lack of resistance of the host just as deaths do occur in pneumonia, diphtheria, *etc.* We can thus state that the organisms that have produced a severe carbuncle of the neck, with recovery if placed in the danger area of the face, most likely will present the usual picture described above with termination of life.

The fact that the hair follicles and sebaceous glands are not well developed until after puberty is the possible reason for the fact that furuncles or carbuncles of the face are not usually present before puberty.

From the primary focus, secondary pathologic complications may develop. The question arises, is the spreading of the primary infection through (*a*) the lumen of the veins, (*b*) the lymphatics, or (*c*) a combination of both? Lenhartz[17] cites cases to show that death may occur from a blood-stream infection, without any thrombophlebitis of the facial or ophthalmic veins, and admits the possibility of lymphatic and cellular routes. However, Doctor Martin commented as follows: "There is no record, however, of a careful dissection of the small veins (facial tributaries) of the face." The only communication between the face (lips and nose) and the skull is through the venous network, as described. The repeated post-mortem findings by numerous observers in a large percentage of cases have conclusively demonstrated that the facial vein and its tributaries must be the vein involved to lead the infection toward the skull. The erosion of a vessel without phlebitis does occur, as, for example, in tuberculous gland of the hilus of the lung, eroding a vessel, giving rise to a blood-stream infection. The absence of a visible thrombosis of a small tributary of the facial vein does not mean that there are no thrombi present. The size of a thrombus, whether it is visible or minute and only recognized by microscopic sections, does not influence the severity of a blood-stream infection. Therefore, the supply of bacteria to the blood-stream either due to a visible infected thrombus, macrosopic or microscopic in size, or through the erosion of a blood-vessel, will give the same clinical picture. The lymph from the skull, and from the face (lips and nose) does not flow through the same afferent vessels or nodes. The lymph can flow in only one direction, that is, toward the heart. Infections can spread through the lymphatics, but appear to be limited in this condition

to a local spread. The preponderance of the facial-vein involvement, with the typical blood-stream infection, metastatic abscesses, and meningeal involvement, speaks for the spreading of the infection primarily through the lumen of the venous networks.

Treatment.—The sphere of treatment has been divided into two groups, the operative and the non-operative, conservative, physical treatment. Powers,[18] Reverdin,[19] and Risenbach[20] favor the operative form of treatment, while Lang,[21] Lenhartz,[17] Keppler,[22] Wrede,[23] Martin,[3] and Hudson[2] believe the conservative, non-operative treatment the better procedure for this condition.

At the Lebanon Hospital, it is a rule to have cases admitted to the wards, whether they be severe or mild, because of the fact that many mild cases have had exacerbations of the process after a period of one to four days of apparent absorption of the infection, and for the reason that one cannot forecast with certainty the outcome. The patients are put to bed, and treated conservatively, by the use of warm, wet dressings continually. Definite instructions to the House Staff are given, forbidding expressing of pus or sloughs from the wound, or the use of a scalpel.

It is a known fact that incisions tend to open the lymphatics and venous channels to further absorption of infection, and for this reason surgeons make incisions wide of the afflicted area in malignant diseases. Incisions are usually made several days after the inflammation has been in progress, at which time nature's barrier of defense has been formed. Therefore, the incision has the same action as trauma, produced by squeezing or picking.

The surgical procedure of ligation of the facial vein had been advocated. Although many have reported cures, it is the general opinion that this procedure should be omitted from the treatment. It is obvious that one is unable to determine, whether a vein or its branches are free from any infected material or are sound enough to be ligated. The application of a ligature about the vein, may result in the dislodging of a thrombus. The ligation of the vein at one place will not necessarily prevent the infection from spreading to the opposite direction.

The treatment found most satisfactory is the use of warm, wet dressings. One readily appreciates the action of heat in increasing the blood-flow to the surface. As a result of this, there is brought more antibacterial and immunologic serum to this area. Thus the object of this treatment is to localize the infected area and to assist in maintaining the barrier of defense and the resistance of the host. This form of treatment is simple, conservative and more effective (Lenhartz[17]).

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HÆMORRHAGE INTO AND INFECTION OF LARGE TUMORS (PACHYDERMATOCELES) OF VON RECKLINGHAUSEN'S DISEASE

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In 1917 one of us[1] described a case which presented the clinical characteristics of von Recklinghausen's disease but in addition a bathing-trunk type of nævus, a spina bifida occulta and recurring hæmorrhages into a large, loose fold of tissue (pachydermatocele) over the lumbar region (Figs. 1 and 2). It is to the last-named condition to which we wish again to refer. The case described in 1917 was the first so far as we could discover in which serious hæmorrhages into the large tumors of von Recklinghausen's disease had been recorded and we shall recall it briefly as the cause of our interest in the subject.

Case I.—The patient, a single man, twenty-four years of age, first was admitted to the Johns Hopkins Hospital, August 29, 1906. Born at full term in a normal labor, he presented at birth a large nævus of the bathing-trunk variety, a large, loose fold of skin involving the lower lumbar region and buttocks and an excessive growth of hair over a localized area in the lumbar region. His life was without particular event until a week before admission to the hospital when about an hour following a rather insignificant injury to his back there appeared a swelling which rapidly grew in size (Fig. 2). A physician was immediately called who confirmed the observation that the swelling was rapidly enlarging. He found the patient very weak, blanched, sweating and almost pulseless—in other words with the signs of acute hæmorrhage. He enclosed the tumor in a pressure bandage and sent him to the Johns Hopkins Hospital. On admission he presented a large, spherical swelling in the mid-lumbar region, 25 centimetres in diameter and raised 9 centimetres above the surrounding body surface. The bathing-trunk nævus was noted, together with numerous smaller areas of pigmentation scattered over the body. The loose folds about the buttocks were described upon which were several small pedunculated tumors (fibroma molluscum). An operation was performed August 31, 1906, which consisted in an incision into the swelling and the evacuation of what was estimated to be two litres of fluid and clotted blood. No source of the bleeding was found. The friable gelatinous tissue composing the wall of the hæmatoma was noted. The spina bifida occulta was not discovered. In September, 1907, October, 1911, and again in September, 1912, a hæmorrhage into the pachydermatocele recurred spontaneously. In each instance the hæmorrhage was manifested by the appearance of a rapidly increasing swelling and the symptoms of a profound anæmia. On his second admission an operation identical with the first was performed with the same findings and the same result. On his third admission, the operation (performed by Doctor Halsted) was more radical and consisted of the total removal of the wall of the hæmatoma. In the course of this operation the spina bifida occulta and meningocele were discovered and more careful notes made of the peculiar gelatinous tissue composing the pachydermatocele, its branching nodular nerve filaments and its large and extraordinarily thin-walled

[1] Heuer, Bruns' Beiträge zur klin. Chir. 1917, 104, 2, 388.

blood-vessels (Figs. 3 and 4). Again the source of the bleeding was not discovered. The fourth operation was similar to the third; but in view of the smaller size of the hæmatoma, not so extensive.

The recurring hæmorrhages into the pachydermatocele in this case indicated the seriousness of this complication, for they repeatedly threatened the life of the patient. The surgical problem of preventing its recurrence was not solved. The total excision of the pachydermatocele was not seriously contemplated for because of its size and position its total removal would have

FIG. 1.—Anterior view of patient showing large nævus on thighs and diffuse pigmentation over the remainder of the body.

FIG. 2.—Posterior view of patient showing bathing-trunk nævus and large tumor (pachydermatocele with hæmatoma) involving lumbar region and buttocks.

been difficult and hazardous. The case remained unique in our experience until 1924 when a patient presented himself who not only illustrated the complication of hæmorrhage but the complication of infection in a large pachydermatocele. His story follows:

CASE II.—A. H., Nos. J-9375, K-1368, N-6123, N-7783, O-5137. A white man, aged forty years, was admitted to the Cincinnati General Hospital, December 29, 1924, because of the rapid swelling of a tumor of the left thigh following an injury three

days previously. His family history was unimportant. Since earliest childhood he had had scattered areas of pigmentation over the body, many small tumors and one large

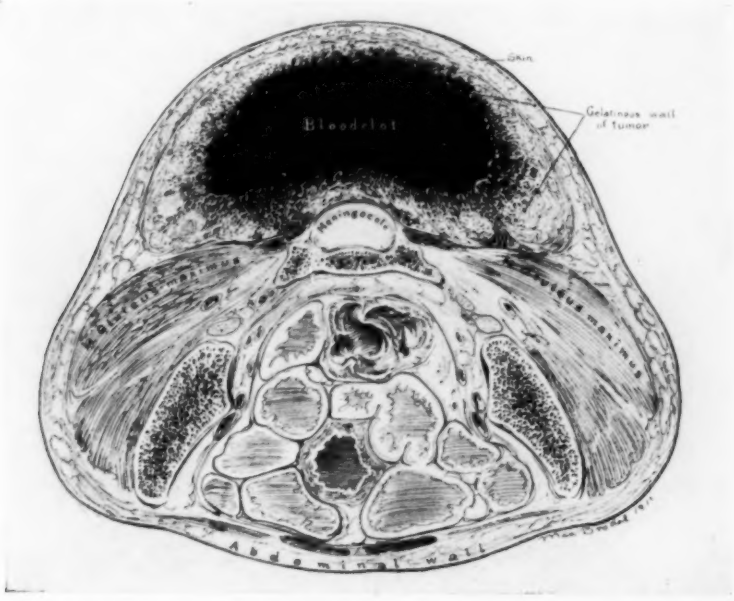

FIG. 3.—Diagrammatic section of the lumbar region of Case I, showing the tumor lying over a spina bifida occulta and meningocele. The blood clot occupies the centre of the pachydermatocele. Preliminary sketch made at operating table by Brödel.

tumor resembling loose folds of skin over his left thigh. Ten years ago an attempt was apparently made to remove the tumor of the thigh; but the removal must have been incomplete for since that time the tumor had grown in size until it had reached

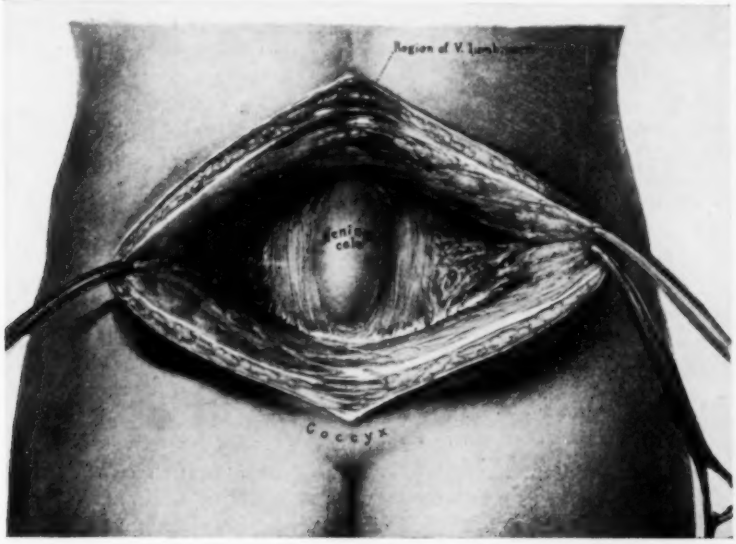

FIG. 4.—Sketch made at operating table showing the meningocele discovered after the removal of the anterior wall of the hæmatoma.

its present proportions. Three days before admission he fell a short distance, striking his left hip and bruising the tumor. A few moments after the injury the tumor over his hip rapidly increased in size and then more slowly enlarged until his admission to the hospital. It became painful and over its most prominent portion showed a bluish-black

FIG. 5.—Anterior view of Case II, showing pigmentation over the body. This photograph was taken after the removal of the pachydermatocele.

FIG. 6.—Posterior view of Case II, showing the pigmentation and small cutaneous tumors. The photograph was taken after the removal of the pachydermatocele and the tumor of the right thigh.

discoloration of the skin. At the place of greatest discoloration the skin broke down and there was a discharge of dark blood and blood clots from the opening. There is no history of shock following the injury.

Examination showed a man with the characteristic manifestations of von Recklinghausen's disease: extensive pigmentation over the body, multiple cutaneous and subcutaneous tumors, a deeply situated tumor in the right thigh along the course of the sciatic nerve (neurofibroma) and a large pachydermatocele of the left thigh (Figs. 5 and 6). The pachydermatocele (Fig. 7) was covered with coarse, wrinkled, deeply pigmented skin thrown into many and deep folds. The tumor was generally soft but presented about its centre an indurated area 3 inches in diameter in the centre of which was a crescentic opening in the skin from which exuded a bloody fluid and in the depths of which was apparently a large blood clot. Gentle pressure about this indurated area caused the discharge of blood clots from the wound. The patient's general condition was good. His temperature and pulse were normal.

The patient remained in the ward from December 29, 1924, to January 16, 1925. During this time the blood clot was completely discharged from the tumor, the tumor diminished in size and the wound very largely closed. The patient was advised to have the pachydermatocele removed but he refused.

The patient was re-admitted to the hospital, February 17, 1925, complaining of pain in and swelling of the tumor of two days' duration. Examination showed the skin over

FIG. 7.—Photograph of the left side of Case II, showing the large pachydermatocele. Above it extended almost to the iliac crest, below it involved the upper portion of the thigh and posteriorly overhung the buttock. The crescentric opening appears about the centre of the mass.

FIG. 8.—Photograph of the left side of Case II, showing the result following the removal of the pachydermatocele.

the pachydermatocele reddened and hot, and the tumor itself considerably enlarged. The whole mass was tender on manipulation and quite œdematous. There was no fluctuation anywhere suggesting an abscess. The wound noted on the previous admission was not quite healed and exuded a thin, watery, slightly turbid discharge. It appeared that there was a rather diffuse infection throughout the tissues of the pachydermatocele without abscess formation. The patient's temperature on admission was 100° and his leucocytes 25,000. His temperature remained at about this level for ten days after admission, then rose to 102.6°. It varied between 100° and 102° for another ten days, then rose to 106°. His pulse increased to 144. For a week his temperature showed the greatest variations, rising to 106°, again falling to 99°. For another eight days it fluctuated between 100° and 102°, then gradually came to normal. For a period of thirty-five days, therefore, the patient had a markedly elevated temperature associated with a high leucocytosis (varying between 25,000 and 40,000). During the period of greatest elevation he was quite toxic and ill but had few complaints. The cultures from the discharging wound showed streptococci. Throughout his febrile period the pachydermatocele was red, hot, greatly swollen and tender but never showed signs of fluctuation.

There appeared, however, on the thirty-first day of his admission a small secondary infection with abscess formation over his right sacrum (the pachydermatocele was on the opposite side). The abscess was opened and cultures from the pus showed streptococci. Wishing to be sure that there was no other focus of infection the patient was subjected repeatedly to every sort of examination, always with negative results. Blood cultures were always negative.

After this bout of illness the patient was quite ready to have the pachydermatocele removed. He was, however, greatly weakened and emaciated as a result of his protracted fever. Moreover we did not wish to operate too soon after the infection. The operation was therefore postponed for over a month.

Operation.—April 25, 1925. The entire tumor was encircled by an incision carried down to the deep fascia of the thigh. The greater part of the tumor lay superficial to the deep fascia and could readily be stripped off from this structure. Here and there, however, the tumor penetrated the fascia and extended more deeply into and between the muscles and in these locations probably some of the tumor was left behind. The tumor presented the usual gelatinous appearance and contained numerous large and extremely thin-walled blood-vessels. Its removal, however, was not attended with difficulties or considerable hæmorrhage. The huge wound was drawn together above and below as much as possible and sutured. There was left a large defect which later was successfully skin grafted (Fig. 8).

The patient was discharged from the hospital on May 27, 1925, apparently well. His subsequent history does not concern our present subject; but it may be said that two years after the successful removal of the pachydermatocele he was re-admitted with a large tumor of the posterior surface of the right thigh associated with great pain. This was found at operation to arise from the sheath of the sciatic nerve and was apparently completely removed. It proved to be a sarcoma and following operation a series of X-ray treatments was given. A year after its removal he returned with local recurrences, two of which lay beneath the scar. A high thigh amputation was done because of great pain. For another year he was in fair health, then returned with a local recurrence in the amputation stump and generalized sarcomatous metastases. He remained in the hospital until his death.

Comments.—The hæmorrhage into the pachydermatocele in this case was of no great moment but the subsequent infection within the tumor presented a difficult problem. This infection spread rapidly throughout the tumor and caused a great increase in its size. The furrowed skin became red, thinned and shiny, the whole tumor mass boggy and œdematous. The usual measures, such as hot compresses of isotonic or hypertonic salt, of aluminum acetate, of epsom salts, etc., had no effect whatever upon the infection. Moreover, after the application of such compresses for forty-eight hours the skin always became macerated and threatened to break down. Dry heat had no more effect. Incisions into the mass seemed contraindicated. Had incisions been contemplated it would have been difficult to decide where to make them; moreover, it seemed very problematical what they would accomplish. One could imagine merely a protruding mass of œdematous gelatinous tissue filling the incision as soon as it was made, with the possibility of serious hæmorrhage from the incised tissue. To observe an infection progress for thirty-five days with the temperature and leucocytes mounting and to be at a loss for measures to check it is an unhappy situation; and on several occasions we were on the point of deliberately excising the entire mass during

the height of the infection. Fortunately the infection spontaneously subsided. The problem of how properly to deal with such an infection remains to us unanswered.

Our third case is an instance of a fatal hæmorrhage into a pachydermatocele, the first so far as we can find to be recorded. His history briefly is as follows:

CASE III.—N. T., No. K-5692. White, male, age thirty-two years. The patient was admitted to the Cincinnati General Hospital, July 21, 1925, complaining of a rapidly increasing tumor on his back. His family history was unimportant. From birth it was noticed that he had a pigmented mole on his back, the size of a silver dollar, lying just to the left of the spine between the shoulder blades. This was covered with a fine, downy hair. The pigmented area gradually increased in size and at the age of ten years was about the size of a saucer. There appeared in this region at an unknown date but early in life a tumor mass which gradually grew in size until it was of considerable proportions. This mass gave him no discomfort except from its weight. He gradually became round shouldered and stooped but whether this was the result of the weight of the tumor of his back or due to a disease of his spine was not discovered. At any rate he never had any symptoms with reference to his spine. In addition to this one large tumor there appeared over his upper trunk many small tumor masses, presumably neurofibromata. Although the patient was always undersized and of delicate constitution he was engaged in work of various sorts until just previous to his admission to the hospital.

In the night of July 14, 1925, the patient called his brother because of pain in the large tumor upon his back. The brother applied hot towels and "Sloan's liniment" which resulted in vesication of the skin over the mass. The vesicles were pricked and witch hazel applied. During the night of July 21, 1925, while arising from bed to take some medicine which had been prescribed for him the patient felt a sharp, sudden pain in his back and said something "broke loose inside" the tumor. The mass increased rapidly in size and became purplish in color.

He was admitted to the Cincinnati General Hospital at 11:30 P.M. July 21, 1925. He was in profound shock; he was extremely pale and cold and in a profuse perspiration; he had extreme air hunger, was anxious and frightened, and constantly crying out for water; his pulse was very rapid and imperceptible at the wrist. The rate counted over the heart varied from 160 to 180 per minute. He was immediately placed in a hot bed; morphine was given to control his restlessness; oxygen was administered for his dyspnœa, and normal saline was given both subcutaneously and intravenously. His condition was so desperate that a complete physical examination was deemed inadvisable. He lay upon his side so that the tumor mass could be readily examined. This was an enormous tumor arising from the back between the shoulder blades, pear shaped, and fully as large as a large pumpkin. The skin over it was somewhat bluish in color and showed areas of desquamation, the result of previous blistering. There was, however, no ulceration of the skin. On palpation the tumor mass was rather tense but definitely fluctuant. It was quite apparent that a large hæmorrhage had occurred into the tumor mass. The examination also included the notation of numerous small cutaneous and subcutaneous tumors scattered over the chest and back and scattered areas of pigmentation over the body.

The efforts made to overcome the patient's evident shock were without avail. His pulse steadily became more rapid and feeble. His air hunger continued to increase so that the continuous administration of oxygen was resorted to. He continued cold and clammy. He was matched for a blood transfusion but before a blood donor could be obtained he died. An autopsy was not obtained.

Comment.—This patient entered the hospital with all the signs of an acute, severe hæmorrhage, and died within four hours after his admission. The rapid increase in the size of the tumor with bluish discoloration makes it quite evident that the patient bled to death into the pachydermatocele. This is the first case in our experience of a fatal outcome from hæmorrhage.

Before our fourth and last case came under observation there appeared in the *J. A. M. A.*, July 17, 1926, a note by Carrington and Bullitt, describing a case in which a hæmorrhage had occurred in a pachydermatocele of von Recklinghausen's disease. They had failed to find a record of a similar case, having apparently overlooked the case

FIG. 9.—Anterior view of Case IV, showing pigmentation and cutaneous tumors. Photograph taken after the evacuation of the temporal hæmatoma.

FIG. 10.—Posterior view of Case IV, showing the areas of pigmentation and cutaneous tumors. This photograph also was taken after the evacuation of the temporal hæmatoma.

FIG. 12.—Lateral view of Case IV. The photograph was taken after the evacuation of the hæmatoma. The tumor present before operation is outlined on the scalp.

described by one of us in 1917. This patient was a colored man, twenty-two years of age, who since childhood had had numerous small nodules scattered over his body and several of larger size; the largest, the size of an orange located on the right flank. On the morning of July 28, 1925, he was struck upon the right flank by a falling tree. Thirty-six hours after the trauma a swelling involving the pachydermatocele appeared and within two hours increased to the size of his head. When seen there was a mass upon the right side extending from "the lower costal margin to the crest of the ilium and from the erector spinæ muscles forward to a line mid-way of Poupart's ligament." The mass was soft and fluctuant. The patient's general condition was good and he apparently quite failed to show the symptoms of hæmorrhage seen in two of our cases. An operation was performed August 3, 1925, and an incision into the mass

showed a large hæmatoma which was evacuated, leaving a cavity lined "with a slimy, partially organized layer of blood clot." The source of the hæmorrhage was not found. (This has been invariably true of our cases.) The pachydematocele was apparently partially excised, the authors stating, however, that the identification of tumor tissue from adjacent tissue was quite impossible because of the hæmorrhagic infiltration. The patient recovered and was discharged well.

Our fourth case was a colored man whose story follows:

CASE IV.—J. R., No. L-8298. Colored, male, age thirty-three years. The patient was admitted to the Cincinnati General Hospital, September 18, 1926, complaining of a swelling on the left side of his head. His family history was unimportant. Since

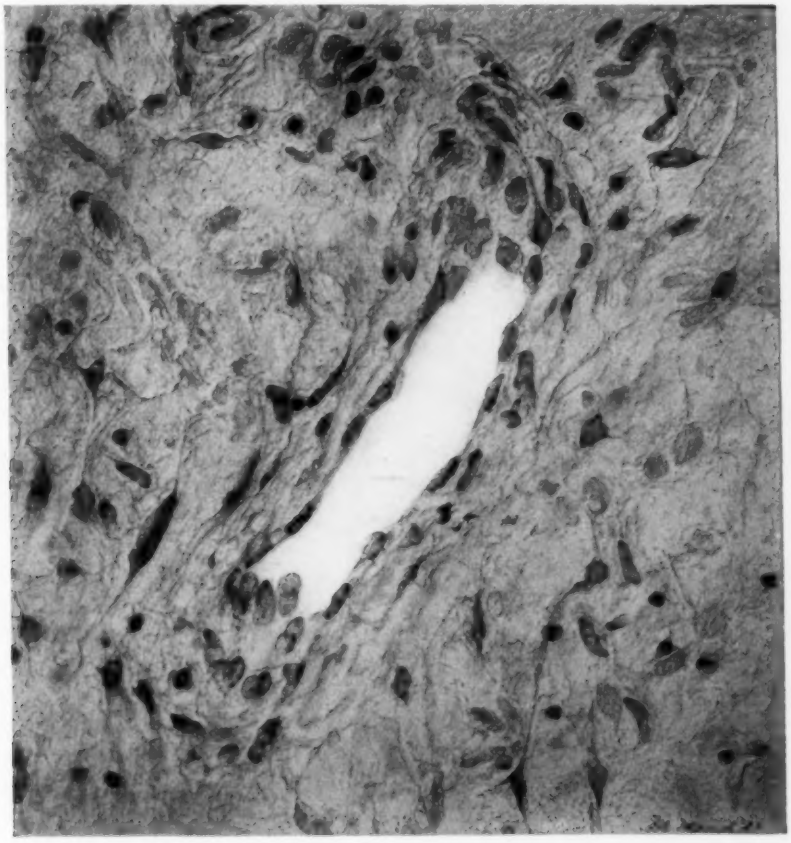

FIG. 11.—Section from pachydermatocele showing the large but extremely thin-walled blood-vessel. The vessel wall consists of an endothelial lining and several strands of connective tissue. No muscular coats are present. The character of the tissue composing the tumor may be seen. The cells are chiefly connective-tissue cells and nerve cells with branching processes. Sections from Cases I and II are exactly similar.

childhood he had known that he had areas of deeper pigmentation over his body and many small tumor nodules of the skin and subcutaneous tissues. These may be seen in the accompanying photographs (Figs. 9 and 10). So far as he was aware there was no tumor of the scalp.

Four days before admission there appeared a small lump, the size of an olive, just above the left ear. This he discovered on combing his hair. He was quite sure that this lump was not present before. There was no history of injury to account for it. This swelling gradually increased in size until it formed a mass as large as a grapefruit

over the left temporal region. It displaced the ear downward and extended sufficiently far forward to close the left eye. The skin over the tumor was tense, rather shiny, but did not present the usual appearances of a pachydermatocele. The swelling was somewhat tender and was definitely fluctuant. An X-ray of the skull was negative. The patient's temperature was 101°, and his leucocytes 11,500. During the patient's stay (two days) in the hospital before operation was undertaken, the mass very definitely increased in size. In view of our former experiences, the diagnosis of hæmorrhage into a tumor of von Recklinghausen's disease was made, although in this case a definite external tumor resembling a pachydermatocele was not present.

Operation.—September 21, 1926, (Dr. Max Zinninger). A vertical incision was made over the tumor mass in front of the ear and parallel to the fibres of the temporal muscle. On dividing the galea the temporal muscle appeared greatly thickened, dark red in color and apparently infiltrated with blood. The muscle was incised and a large amount of blood clot evacuated. The swelling consisted of a huge hæmatoma which lay between the temporal muscle and the periosteum covering the bone. The bone was nowhere exposed. After the fluid and clotted blood were evacuated there appeared a large cavity lined with a gelatinous, dark, reddish tissue of considerable thickness and definitely resembling the myxomatous tissue occurring in pachydermatoceles. A considerable portion of this gelatinous tissue was excised for microscopic section. No source of bleeding was found. The wound was closed without drainage.

The microscopic section of the tissue excised showed a very loosely formed, œdematous-appearing tissue, containing numerous fibrous-tissue cells, with here and there an attenuated strand of muscle. Some of the cells bore a resemblance to the glia cells. The blood-vessels contained in this tissue were extremely numerous; the vessel walls varying in thickness, but the majority being extremely thin-walled (Fig. 11). Strands of fibres resembling branching nerve fibres were observed. The pathological diagnosis was neurofibroma.*

The patient made a satisfactory recovery. The wound healed *per primam*. The swelling decreased in size and eventually the temporal region became quite flat. Unfortunately a photograph of the patient before operation was not taken. The lateral view of the patient (Fig. 12) taken after operation shows the outline of the tumor mass marked upon the scalp with a pencil.

* Dr. M. M. Zinninger states that during his stay in China he observed two cases of von Recklinghausen's disease in which the entire temporal muscle was involved in the tumor. The muscle was 2 inches thick, pale, œdematous, gelatinous and myxomatous in appearance. There was no separation between the galea of the scalp and the muscle, *i.e.* the temporal fascia was not recognizable as such. In the above case the temporal muscle was thickened but not involved in the sense that Zinninger's Chinese cases were.

ACUTE EMPYEMA THORACIS*

A STATISTICAL STUDY WITH A COMPARISON OF THE WHITE AND COLORED RACES

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Since the World War, largely due to the work of the Empyema Commission[1] and the researches of Graham and Bell,[2] the treatment of acute empyema thoracis has become more or less standardized. Considerable clinical investigation has been made by such authorities as Graham,[3] Hedblom,[4] Heuer,[5] Alexander,[6] Phemister,[7] Butler,[8] Bettman,[9] Ashurst,[10] Rienhoff,[11] Mozingo,[12] Eggers,[13] McEnery and Brenneman,[14] and others. These studies have been almost entirely on white patients, both adults and children. As frequently the negro reacts differetly to disease from a white individual, it was thought desirable to study a group of cases of acute empyema thoracis admitted to the Charity Hospital at New Orleans, to which institution both white and colored races are admitted. The present report is based on an analytic study of 124 consecutive cases of acute empyema thoracis occurring in adults admitted to the Charity Hospital during the past ten years. Patients under ten years of age are not included. The results of the study are significant, because the patients were admitted to different surgical services and no uniform treatment was used. Obviously anyone interested in a certain condition will obtain better results in the treatment of that condition than an individual whose interests are less marked. Also the results obtained from a group of cases which are treated by a single method or technic, and in which equally as good results can be obtained by others employing a different technic, are of less value to the general surgeon than a study of a large group of cases in which various types of therapy have been used by different individuals. In the 124 cases here reported most of the presently employed methods of treatment were used and an evaluation of the efficacy of these is probably significant.

Of the 124 patients admitted to the Charity Hospital, eighty (64.4 per cent.) were white and forty-four (35.4 per cent.) were colored. There were ninety-seven (76.2 per cent.) males and twenty-seven (21.7 per cent.) females. When considered according to ages, forty (32.2 per cent.) were between the ages of eleven and twenty years, thirty-three (26.6 per cent.) between twenty-one and thirty, twenty-five (20.1 per cent.) between thirty-one and forty, fifteen (12 per cent.) between forty-one and fifty, and eleven (9 per cent.) above fifty years of age. Of the cases occurring in the white race, 81.2 per cent. occurred in the second, third, and fourth decades, whereas

* Presented before the Southern Surgical Association, December 10, 1930.

73.8 per cent. of those occurring in the colored race occurred in these same decades. This age incidence is comparable to that obtained in the cases of empyema reported by Binney,[15] Wilensky,[16] and Foster,[17] who found that 74.9 per cent., 76.7 per cent., and 77.03 per cent. occurred in the second, third, and fourth decades, respectively, whereas in our entire series, 78.9 per cent. occurred in the second, third, and fourth decades. The mortality rate in our series was highest in those cases occurring after fifty-one years of age (43.6 per cent.). In the fifth decade there were no deaths. There were, however, only fifteen cases. The mortality rate in the second, third, and fourth decades was 12.5 per cent., 13.6 per cent., and 16 per cent., respectively. The average ages of all patients was 31.5 years, the average age in the white race, 30 years, and that in the colored, 33 years. The average age of those which were improved, *i.e.*, discharged from the hospital with draining sinuses, was 29 years in the entire series; in the white race, 26 years, and in the colored race, 32 years. The average age of those which recovered, *i.e.*, discharged from the hospital with a healed wound and with no evidence of empyema, was 30 years; in the white, 27 years, and in the colored, 33 years. The average age of those patients who died was 34.1 years; in the white, 34 years, and in the colored, 34.3 years.

Acute empyema thoracis usually follows a pneumonic process and as a rule follows lobar pneumonia. During influenzal epidemics, however, a lobular variety of pneumonia is the most frequent cause of empyema. The antecedent lesion was stated in 110 of the 124 Charity Hospital cases. Lobar pneumonia was the cause of the empyema in sixty-eight (61.9 per cent.), influenza in twenty (18.1 per cent.), tuberculosis in fourteen (12.8 per cent.), lung abscess in six (5.5 per cent.), a metastatic lesion in one (0.9 per cent.), and a stab wound of the thorax in one (0.9 per cent.). There was relatively little difference between the two races, except that tuberculosis was the underlying lesion in a higher percentage in the colored (19.7 per cent.) than in the white race (8.7 per cent.). Lung abscess, however, occurred more frequently in the white race than in the colored race. The etiology in our series does not differ materially from the series of cases reported by Peck and Cave,[18] Ganz,[19] and Binney[15] with the exception that a relatively larger percentage of cases followed influenza in the Charity Hospital series than in the other groups. The average interval between the onset of pneumonia and the onset of the empyema was thirteen and a half days, the maximum being sixty days, and the minimum, one day. There was practically no difference between the two races. The average interval between the onset of the empyema and the time of operation was fifteen days, the maximum being forty-nine and the minimum being one day.

Symptoms and Signs.—Of the 124 patients, ninety-eight (79.3 per cent.) complained of pain. Only one (0.8 per cent.) had no pain and in twenty-five (20.1 per cent.) it was not stated whether the patient had pain or not. Sixty-five (81.25 per cent.) of the eighty white patients and thirty-three (75 per cent.) of the forty-four colored patients complained of pain. Of the 124

patients, eighty-two (66.12 per cent.) complained of cough, six (4.8 per cent.) had no cough, and in thirty-six (29.03 per cent.) it was not stated. In the eighty white patients and in the forty-four colored patients cough was present in fifty-three (66.25 per cent.) and twenty-nine (65.9 per cent.) respectively. Expectoration was present in forty-four (35.4 per cent.) of the 124 patients; there was none in twenty-four (19.3 per cent.), and it was not stated in fifty-six (45.1 per cent.). Expectoration was present in twenty-five (31.26 per cent.) of the white patients, and in nineteen (43.18 per cent.) of the forty-four colored patients. Of the various physical findings, limitation of thoracic movement, dulness on percussion, absence of breath sounds, and cardiac displacement were most frequently encountered. Of the 124 patients, eighty-two (66.12 per cent.) showed immobility of the chest, seven (7.4 per cent.) showed none, and in thirty-five (28.2 per cent.) it was not stated. Immobility was present in fifty-three (66.25 per cent.) of the eighty white patients and in twenty-nine (65.9 per cent.) of the forty-four colored patients. Dulness on percussion was found in 103 (83.06 per cent.) of the 124 patients. Only two (1.6 per cent.) had none, and in nineteen (15.48 per cent.) it was not stated. Dulness was obtained in sixty-nine (86.26 per cent.) of the eighty white patients and in thirty-four (79.54 per cent.) of the forty-four colored patients. Absence of breath sounds was encountered in fifty-four (43.53 per cent.) of the 124 patients. In six (4.8 per cent.) the breath sounds were increased and in sixty-four (51.6 per cent.) it was not stated. The breath sounds were absent in twenty-seven (33.7 per cent.) of the eighty white patients and in twenty-seven (61.3 per cent.) of the forty-four colored patients. Of the 124 patients, cardiac displacement occurred in thirty-two (25.8 per cent.) instances. It was questionable in seven (5.77 per cent.), absent in eighteen (14.15 per cent.), and was not stated in sixty-seven (54.03 per cent.). Cardiac displacement was present in twenty-four (30 per cent.) of the eighty white patients, and eight (18.1 per cent.) of the forty-four colored patients. The symptoms and signs in both races combined as in the individual races in the order of their frequency in the present series were: 1, dulness on percussion; 2, pain; 3, cough; 4, limitation of thoracic movement; 5, absent breath sounds; 6, expectoration; and 7, cardiac displacement. There was relatively little difference between the two races except that absent breath sounds occurred about twice as frequently in the colored as in the white. This difference is difficult to explain because large quantities of pleural exudate, as evidenced by the amount of fluid aspirated and the cardiac displacement, were encountered more in the white race than in the colored.

The average maximum and minimum pre-operative temperatures were 101.9 degrees and 97.9 degrees F., respectively. The average maximum and minimum pre-operative pulse rates were 124 and 81, respectively; there was practically no difference between the two races. A leucocyte count was made in sixty-two cases; the average count was 20,162 cells per cubic millimetre with an average of 83 per cent. polymorphonuclear leucocytes. A slightly

higher leucocytosis existed in the thirty-six white patients (21,791 with 84 per cent. polymorphonuclear leucocytes) than in the twenty-six colored patients (18,072 with 82 per cent. polymorphonuclear leucocytes) in which a leucocyte count was made.

In the series empyema occurred on the right and left sides with equal frequency, sixty-eight times each, in five cases there was a bilateral process. The mortality rate was somewhat higher in the cases with right-sided empyema (17.16 per cent.) than in those in which the left side was involved (10.3 per cent.). However, in the colored race, the mortality in left-sided empyema (33.3 per cent.) was definitely higher than in the right-sided processes (5 per cent.), and in the white race the mortality was higher in right-sided (13.16 per cent.) than in left-sided lesions (3.9 per cent.). In Rienhoff and Davison's[11] series the mortality rate was almost twice as high in left-sided as in right-sided empyemas. In Farr and Levine's[20] series of cases right-sided and left-sided empyemas had 16 per cent. and 24 per cent. mortality rates, respectively. On the other hand, in the cases reported by Beust[21] right-sided empyemas were associated with a mortality rate of 29 per cent., whereas of the patients with left-sided empyema, 13.6 per cent. died. In a series of cases collected from the literature and including the Charity Hospital series the right side was involved in 435, the left side in 525, and the process was bilateral in twenty-seven.

Of utmost importance as regards the treatment and prognosis in acute empyema is the type of empyema. As emphasized by the Empyema Commission[1] and other observers, the synpneumonic type of empyema, *i.e.*, the empyema which occurs concomitantly with the pneumonic process, is associated with a higher mortality than other types of empyema. On the other hand, the metapneumonic type, that in which the empyemic process follows the subsidence of the pneumonic process, offers a much better prognosis. In 111 cases of the present series, the type of empyema was stated. It was of the metapneumonic variety in sixty-seven cases (60.3 per cent.), of the synpneumonic type in twenty-four (21.6 per cent.), of a tuberculous nature in fourteen (12.6 per cent.), and staphylococcic in six (5.4 per cent.). Rather significant is the relatively high percentage of acute tuberculous (secondarily infected) empyemata occurring in the negro, 20.5 per cent. as compared with 8.3 per cent. in the white..

Of the sixty-seven cases of metapneumonic empyema improvement occurred in fifty-three (79.1 per cent.), recovery in nine (13.4 per cent.), and death in five (7.4 per cent.). There was little difference between the two races except that the metapneumonic variety occurred in 63.6 per cent. of the colored patients and 53.7 per cent. of the white patients. Of the twenty-four cases in which synpneumonic empyema was present, seventeen (21.25 per cent. of all the white patients) occurred in the white race, and seven (15.9 per cent. of all the colored patients) in the colored. Of the twenty-four cases of synpneumonic empyema fourteen (58.4 per cent.) improved, four (16.6 per cent.) recovered, and six (25 per cent.) died. Of

the fourteen cases in which the underlying lesion of the pleura was a tuberculous one, six occurred in the white and eight in the colored race. All of those occurring in the white race and half of those occurring in the colored race improved. Of the entire fourteen cases, ten (71 per cent.) were improved and four (29 per cent.) died. Six cases of staphylococcic empyema were treated, all of which occurred in the white race. Five were improved and one recovered.

A knowledge of the type of exudate within the pleural cavity is of extreme importance, both from the standpoint of prognosis and treatment in empyema. Early in the course of influenzal or streptococcic empyemas, the fluid is usually hæmorrhagic or serous and contains relatively little fibrin, the fibrin being present in the form of flakes. It is in this stage of the process that the mediastinum retains its mobility and that open operation is especially dangerous. It is imperative before undertaking the treatment of any case of empyema to determine the character of the fluid present. In the Charity Hospital series in ninety-six cases (77.4 per cent. of the whole) the pleural exudate was purulent, in five (3.98 per cent.) it was serous, in six (4.83 per cent.) it was hæmorrhagic, and in fifteen (12.09 per cent.) the character of the fluid was not stated. The prognostic value of the character of the fluid is demonstrated well in this series of cases, as 75 per cent. of the cases with purulent fluid were improved, 17.7 per cent. recovered, and only 7.3 per cent. died, whereas 40 per cent. of the patients with serous effusion were improved, 40 per cent. recovered, and 20 per cent. died, and 100 per cent. of the patients with hæmorrhagic fluid died. Of the ninety-six patients with purulent exudate, sixty-two were white and thirty-four were colored. There is relatively little difference between the two races except that only 3.2 per cent. of the white patients with purulent pleural exudate died, whereas 14.7 per cent. of the colored patients with the same type of fluid succumbed.

A knowledge of the offending organism is extremely important not only as regards prognosis but also as regards treatment. The prognosis and treatment depend upon a knowledge of the offending organism not only because of the difference in the toxæmia, but also because of the difference in the reaction in the pleura produced by the various organisms. An empyema caused by the pneumococcus is usually metapneumonic in type and the reaction of the pleura is characteristic in that there is produced a large amount of thick purulent exudate which is rich in fibrin and contains many leucocytes. There is also an early fixation of the mediastinum. A streptococcic empyema, on the other hand, is usually synpneumonic in type, is associated, at least in the early stages of the condition, with no fixation of the mediastinum. The pleural exudate in streptococcic empyema is characteristic in that it is either serous or hæmorrhagic, thin, watery, and contains flakes of fibrin and relatively few leucocytes. The prognosis in the streptococcic empyemas is much worse than in the pneumococcic variety.

In the Charity Hospital series cultures were reported in ninety-one cases.

Of this number fifty-six (62.2 per cent.) showed pneumococci, sixteen (17.5 per cent.) showed streptococci, six (6.6 per cent.) showed staphylococci, and twelve (13.2 per cent.) were sterile. Of the fifty-six patients whose pleural fluid contained pneumococci, forty-three (76.7 per cent.) improved, eight (14.2 per cent.) recovered, and five (8.9 per cent.) died. Of the sixteen with streptococci seven (43.7 per cent.) improved, three (18.7 per cent.) recovered, and six (37.5 per cent.) died. Of the six with staphylococci five (83.3 per cent.) improved and one (16.6 per cent.) recovered, whereas of the twelve patients with sterile pleural exudates nine (75 per cent.) improved and three (25 per cent.) died.

The Treatment of Empyema.—The treatment of empyema should accomplish the following: 1, relief of toxæmia; 2, relief of increased intrathoracic pressure; 3, evacuation of intrapleural fluid; 4, establishment of the function of the lungs by causing reëxpansion; 5, prevention of the condition from becoming chronic.

Toxæmia may be lessened to a considerable extent by the cautious removal of pleural fluid without opening new avenues for its absorption. The general care of patients suffering with acute empyema should not be neglected. The question of diet has been emphasized repeatedly. Bell[2] showed that unless attention is paid to diet these patients are likely to have a negative nitrogen balance which in adults may amount to as much as 21 grams a day. His investigation showed that if a diet of from 1,500 to 1,700 calories a day was maintained that a negative nitrogen balance always existed, the nitrogen loss being principally in the urine (from 20 to 30 grams a day), whereas only about 2 grams daily were lost in the pleural exudate. The Empyema Commission[1] advocated a basal diet of from 3,300 to 3,500 calories per day in acute empyema.

Intrathoracic pressure may produce a kinking of the large vessels, especially of the inferior vena cava. As a result of collapse of the lung, the pressure within the lesser circulation is definitely increased. Increased intrathoracic pressure is best treated by aspiration, which should be employed in all types of empyema. Aspiration should always be used as a diagnostic procedure before any other type of surgical therapy is attempted. It is indeed the only method which can be used in the synpneumonic type, especially that due to streptococci, before the fluid becomes purulent.

Evacuation of the pleural fluid may be accomplished in a number of different ways. One is impressed in a review of the literature by the diversity of opinion concerning the proper type of treatment. Prior to the World War, the most common form of therapy was "open" thoracotomy by means of rib resection. As a result of the work of the Empyema Commission[1] and especially the researches of Graham and Bell[2] more conservative procedures became popular, especially in the streptococcic empyemas. At the present time, even though a large number of surgeons prefer an "open" operation, a still larger number employ some type of "closed" drainage, especially supplemented with irrigation of the pleural cavity. In the synpneumonic type of empyema, particularly the streptococcic variety, it is imperative that the

pleural contents be evacuated in such a way that an open pneumothorax is avoided, and at present no one advocates the production of an open pneumothorax early in the course of streptococcic empyema. Even those surgeons who prefer "open" drainage and rib resection strictly adhere to the rule that preliminary aspiration should be performed until the character of the pleural fluid is changed, indicating that the mediastinum has become fixed. The advantage of such therapy is appreciated when one considers the results reported by Stone.[22] In a series of 310 cases of empyema treated at Camp Fort Riley, the following results were obtained: In the first series of eighty-five cases which were treated from October 20, 1917, to January 21, 1918, by early thoracotomy, there was a mortality of 61.2 per cent. In the second series of ninety-six cases, observed from January 12, 1918, to August 10, 1918, and treated by early aspiration and late thoracotomy, there was a mortality of 15.6 per cent., whereas in the third series (October 18, 1918, to February 14, 1919) in which the same therapy was used, the mortality rate was only 9.5 per cent. In addition to being of diagnostic and palliative therapeutic value, repeated aspirations are frequently curative. In the series reported by Stone[22] 11.3 per cent. were cured by aspiration alone. Graham[3] states that from 10 to 15 per cent. of the patients with empyema are cured by aspiration. Aspiration alone was used in twelve instances in the Charity Hospital series. In four (33.3 per cent.) instances a recovery resulted. In one instance (8.4 per cent.) improvement resulted, and in four (33.3 per cent.) death occurred. Aspiration alone was employed in four cases of empyema with purulent exudate, two of which were improved, one recovered, and one died. One patient treated by aspiration alone with hæmorrhagic pleural exudate died. The average amount aspirated was 405 cubic centimetres, the maximum being 2,000, and the minimum being 10 cubic centimetres. Two cases of tuberculous empyema with secondary infection were treated by aspiration alone, one of which recovered, and one of which died. In contrast to the cures reported by the above-mentioned authors, the following observers have never obtained a complete recovery by aspiration alone: Peck and Cave,[18] Pickhardt,[23] Farr and Levine,[20] Alexander,[6] and Hodge.[24]

The combination of aspiration of the pleural fluid with intrapleural introduction of air has been advocated by Elias[25] and Danna.[26] The former author reported in 1925 that he had been employing this technic for a period of seven years in a large number of cases with very satisfactory results. The introduction of air after the removal of pleural fluid has been used previously in the treatment of certain of the chronic varieties of pleuritis, especially those of the tuberculous type. Elias claims to be the first, however, to employ this technic in the treatment of suppurative pleurisy. Danna, working independently of Elias, has employed this technic in thirty-five cases of acute suppurative pleurisy since 1923. In the series of cases treated by Danna there was one death, a mortality rate of only 2.8 per cent. In some few cases in which the pleural exudate was especially thick and in which there was a large quantity of fibrinous exudate within the pleural cavity,

Danna employed a small intercostal incision through which fibrinous exudate could be evacuated, following which no attempt was made to keep the wound open. In our analysis of the Charity Hospital series, aspiration of the pleural fluid combined with air injection was used in twenty-nine cases, two of which subsequently had rib resection. Many of these patients were under Danna's care and are included in his previous reports. Of the twenty-nine cases, thirteen (44.8 per cent.) were improved, ten (34.4 per cent.) recovered, three (10.3 per cent.) were unimproved, and three (10.3 per cent.) died. In comparing the two races considerable difference in mortality is seen to exist, there being a 33.3 per cent. and a 4.3 per cent. mortality in the colored and white races, respectively. This discrepancy may, however, be due to the comparatively small number of cases. Of eleven cases of metapneumonic empyema, all white, treated by repeated aspirations associated with air injection, six (54.5 per cent.) improved and five (45.4 per cent.) recovered. Five cases of synpneumonic empyema were treated by aspiration, one by aspiration alone and four by aspiration together with air injection. One of these patients improved, two recovered, and two died. Two cases of tuberculous empyema were treated by aspiration plus air injection, one of which recovered and one died. Two cases of staphylococcic empyema were treated by air injection plus aspiration, one of which recovered and the other was improved. Aspiration plus air injection was used in twenty instances of empyema with purulent fluid, resulting in eleven recoveries, eight improvements, and one death. Two patients with serous exudate in the pleural cavity recovered following aspiration alone and one recovered following aspiration plus air injection. The average number of aspirations and air injections was four, the maximum fifteen, and the minimum one. The average amount of pus evacuated before air injection was 529 cubic centimetres, the maximum 2,800 cubic centimetres, and the minimum 15 cubic centimetres. The average amount of air injected after aspiration of pus was 546 cubic centimetres, the maximum 2,300 cubic centimetres, and the minimum 35 cubic centimetres.

Intercostal drainage was used in forty-one cases, five of which were treated by preliminary aspiration. Of these forty-one cases, thirty-three (80.5 per cent.) improved, three (7.3 per cent.) recovered, and five (12.2 per cent.) died. One of these patients subsequently had a rib resection. An intercostal drainage was performed in twenty-five instances of metapneumonic empyema; eighteen (72 per cent.) were improved, four (16 per cent.) recovered, and three (12 per cent.) died. There was little difference between the two races except that the mortality rate in the colored was lower (8.3 per cent.) than in the white (15.3 per cent.). One of these patients subsequently had a rib resection. Intercostal drainage was associated with open drainage four times. Each patient recovered. It was associated with closed drainage in twenty-one instances, of which fourteen were improved, four recovered, and three died. Four cases of synpneumonic empyema were treated by intercostal drainage, all of which were improved. Two of these were treated with closed drainage and two with open drainage. One patient subsequently had a rib resection. One case in a negro, in which intercostal

and closed drainage was used, died. Two cases of tuberculous empyema were treated by intercostal and closed drainage, one of which had previously been treated by aspiration. Both were improved. Two cases of staphylococcic empyema were treated by intercostal and closed drainage, both of which were improved. Five patients with purulent exudate had intercostal and open drainage; four were improved and one died. Twenty-two patients had intercostal and closed drainage, of which ten had closed pneumothorax. Of the twenty-two, improvement occurred in seventeen (77.3 per cent.) and recovery in five (22.7 per cent.). One patient with serous exudate treated by intercostal and closed drainage was improved. Two patients with hæmorrhagic and pleural exudate treated by intercostal drainage died.

In fifty-three patients a rib resection was performed. One had had a preliminary intercostal incision, and nine had had preliminary aspirations; thirty-four of these patients were white and nineteen colored. Of the fifty-three cases, forty-two (79.2 per cent.) improved, three (5.6 per cent.) recovered, one (1.9 per cent.) was unimproved, and seven (13.2 per cent.) died. Rib resection was employed in thirty-two of the sixty-seven cases of metapneumonic empyema. In the thirty-two cases, rib resection was associated with open drainage in twenty-five instances and with closed drainage in seven. Of those patients who had a rib resection and an associated open drainage twenty-four (96 per cent.) improved and one (4 per cent.) died. The only death occurred in a negro. In seven cases in which rib resection was associated with closed drainage, improvement occurred in six (85.6 per cent.) and death in one (14.2 per cent.). Ten cases of synpneumonic empyema were treated by rib resection, only one of which was treated by means of closed drainage, it being complicated by a closed pneumothorax. Of the nine cases treated by rib resection and open drainage, five (55.5 per cent.) improved, one (11.1 per cent.) recovered, and three (33.3 per cent.) died. Six cases of tuberculous empyema were treated by rib resection and open drainage, of which number four improved, one of which had previously been treated by aspiration plus air injection, and two died. Two cases of staphylococcic empyema were treated by rib resection and open drainage, both of which improved. Forty patients with purulent pleural exudate had rib resection and open drainage performed, of which number thirty-four (85 per cent.) improved, three (7.5 per cent.) recovered, and three (7.5 per cent.) died. Six patients had a rib resection and closed drainage, all of which had closed pneumothoraces; five were improved and one recovered. Of five patients with serous pleural exudate only one died, this patient being treated by rib resection and open drainage.

To summarize the treatment used in the Charity Hospital series in the 124 cases, aspiration alone was employed in twelve cases (8.8 per cent.), aspiration plus air in twenty-nine cases (21.5 per cent.), intercostal drainage in forty-one cases (30.3 per cent.), and rib resection in fifty-three cases (39.2 per cent.). The lowest mortality (10.3 per cent.) was obtained by the aspiration of the pleural contents combined with air injections. There was, however, little difference between the results obtained by this therapy and

those obtained by intercostal drainage (12.1 per cent.) and rib resection (13.6 per cent.). The highest percentage of good results, *i.e.*, those recovering and improved, was obtained by intercostal drainage (87.7 per cent.) and rib resection (84.8 per cent.).

There is considerable controversy among authorities concerning the danger of the production of an open pneumothorax in the treatment of acute empyema. As mentioned and emphasized above, open pneumothorax is to be avoided early in the course of the synpneumonic type of empyema, especially the streptococcic variety. Concerning the relative merits of the "open" and "closed" drainage, it might be said, in general, that everything else being equal "closed" drainage is theoretically the ideal procedure in that it is certainly much more physiologic than "open" drainage. Ideally closed drainage results in an evacuation of the pleural contents without the production of an open pneumothorax, maintaining at all times the normal negative pressure within the pleural cavity and in this way favors the reëxpansion of the lung, which results in its early return of function. Practically, however, ideally as "closed" drainage may appear, it has very definite disadvantages. It is undoubtedly the ideal method of treatment in those institutions in which there is adequate help available in order that the drainage system may be kept open and functioning. However, there is a probability especially in the pneumococcic type of empyema, that the system may become clogged by masses of fibrin. Because of this, "open" thoracotomy accomplished by rib resection is the better procedure in those cases in which proper supervision is not possible. It is a more "fool-proof" method. In the Charity Hospital series of cases, forty-eight (45.2 per cent. of those cases in which the type of drainage was stated) were treated by open drainage, of which number thirty-seven (77 per cent.) were improved; three (6.2 per cent.) recovered; one (2.1 per cent.) were unimproved; and seven (14.5 per cent.) died. The most significant difference between the races was that apparently the negro did not stand "open" drainage so well as did the white patient. The mortality following open drainage in the colored race was 26.3 per cent. as compared with 6.9 per cent. in the white. The number of cases, however, is small. Fifty-seven cases (54.2 per cent. of those cases in which the type of drainage was stated) were treated by closed drainage, of which number twenty-five had an associated closed pneumothorax. Four of these patients subsequently had open drainage performed. Of the fifty-seven, forty-four (77.2 per cent.) improved, six (10.5 per cent.) recovered, and seven (12.2 per cent.) died. The mortality following closed drainage in the Charity Hospital series was slightly lower than in those cases in which open drainage was employed.

The type of anæsthetic employed was local infiltration in 100 cases, ethylene in four, and in twenty the type of anæsthetic was not stated.

Post-operatively, irrigation was employed in sixty-six patients, forty-one in the white and twenty-five in the colored patients. No irrigation was used in eight instances in the white race and in four of the colored. It is not stated whether irrigation was used in thirty-one cases of the white race and in nineteen of the colored. Of the forty-one times irrigation was used in

the white, improvement occurred in 71.3 per cent. and recovery occurred once. In the thirty cases in which irrigation was used in the colored, improvement occurred in twenty instances (66.6 per cent.) and recovery twice. Dakin's solution was used in thirty-two cases alone and in combination with saline in six additional cases. In the thirty-two cases in which Dakin's solution was used alone, recovery resulted twenty-eight times (87.5 per cent.), and death four times 12.4 per cent.). Saline solution was used alone in fifteen cases. Hexylresorcinal (ST 37) was used alone in one case and once in combination with Dakin's solution. Mercurochrome and gentian violet were used twice each. Post-operatively, lung gymnastics were employed in fourteen cases.

Complications developed in thirty-two (25.8 per cent.) cases, eighteen (56.2 per cent.) of which improved subsequently. Twenty (62.5 per cent.) of the thirty-two cases which developed complications occurred in the white race, and twelve in the colored. In the twenty white cases, thirteen (65 per cent.) recovered and seven (35 per cent.) died. In the twelve colored cases, five (41.6 per cent.) improved and seven (56 per cent.) died. Acute nephritis occurred in seven cases (21.8 per cent.), abscess of the chest wall in three (9.3 per cent.), twice associated with closed drainage and once with open drainage. Bronchial fistulæ occurred only five times (15.6 per cent. of all complications).

The results obtained in the treatment of acute empyema thoracis are variable and are dependent upon many factors, as we have attempted to illustrate. The results obtained in the Charity Hospital cases compare favorably with other reports, as in the 124 cases there were nineteen deaths (15.3 per cent. mortality), a 10 per cent. mortality in the white race and a 25 per cent. mortality in the colored race. Eighty-four (67.7 per cent.) of the patients were improved, eighteen (14.5 per cent.) recovered, and three (2.4 per cent.) were unimproved. Of the eighty white patients, fifty-five (67.5 per cent.) were improved, fourteen (17.5 per cent.) recovered, and three (2.75 per cent.) were unimproved. Of the forty-four colored patients, twenty-nine (65.9 per cent.) were improved and four (9.09 per cent.) recovered.

SUMMARY AND CONCLUSIONS

In an analysis of 124 cases of acute empyema thoracis admitted to the Charity Hospital at New Orleans, it was found that a higher percentage of cases occurred in the white race (64.4 per cent.) than in the colored (35.4 per cent.). The greatest number of cases were between the ages of eleven and twenty years; 78.9 per cent. occurred in the second, third, and fourth decades. The mortality rate was highest above fifty years of age.

Lobar pneumonia was the cause of empyema in 61.9 per cent., influenza in 18.1 per cent., tuberculosis in 12.8 per cent., lung abscess in 5.5 per cent., and a metastatic lesion and stab wound of the thorax each in 0.9 per cent. Tuberculosis was the underlying lesion in 19.7 per cent. of the colored patients and in 8.7 per cent. of the white patients.

The signs and symptoms presented by the patients in the present series in order of their frequency were as follows: 1, dulness on percussion; 2, pain; 3, cough; 4, limitation of thoracic movement; 5, absence of breath sounds; 6, expectoration; and 7, cardiac displacement.

Right-sided and left-sided empyemas occurred with equal frequency. In the colored race the mortality was higher in left-sided (33.3 per cent.) than in right-sided processes (5 per cent.), whereas in the white the mortality in the right- and left-sided lesions was 13.16 per cent. and 3.19 per cent., respectively.

Empyema was of the metapneumonic variety in 60.3 per cent., of the synpneumonic type in 21.6 per cent., tuberculous in 12.6 per cent., and staphylococcic in 5.4 per cent. Improvement and recovery occurred in 92.24 per cent. of the metapneumonic cases, in 75 per cent. of the synpneumonic cases, and in all the staphylococcic cases. Improvement occurred in 71 per cent. of the tuberculous cases.

The pleural fluid was purulent in 79.03 per cent. of the cases (mortality rate 7.3 per cent.), serous in 3.98 per cent. (mortality rate 20 per cent.), and hæmorrhagic in 4.83 per cent. (mortality rate 100 per cent.).

In the treatment of empyema in the present series of cases aspiration alone was used in 8.8 per cent. of the cases, aspiration plus air injection in 21.5 per cent., intercostal drainage in 30.3 per cent., and rib resection in 39.2 per cent. Aspiration alone resulted in improvement or recovery in 41.7 per cent. of the cases in which it was employed. Aspiration of the pleural exudate combined with air injection gave improvement or recovery in 79.2 per cent. of the cases in which it was used. There was a mortality rate of 10.3 per cent. Intercostal drainage resulted in improvement in 80.5 per cent., recovery in 7.3 per cent., and death in 12.2 per cent. Rib resection gave the following results: 79.2 per cent. were improved, 5.2 per cent. recovered, and 13.2 per cent. died. The lowest mortality, 10.3 per cent., was obtained by aspiration of the pleural contents combined with air injection.

Open drainage was employed in 45.2 per cent. of the cases, of which number 14.5 per cent. died and 83.2 per cent. were improved or recovered. The mortality rate in the negro following open drainage was 26.3 per cent., whereas that in the white patients was 6.9 per cent. Closed drainage was used in 54.2 per cent., of which number 12.2 per cent. died and 87.7 per cent. were improved or recovered. Complications developed in 5.8 per cent. of the cases. Of the complications, 62.5 per cent. occurred in the white race. Acute nephritis, representing 21.8 per cent. of all complications, was the most frequent complication encountered. Of the complications, bronchial fistula and abscess of the chest wall represented 15.6 per cent. and 9.3 per cent., respectively. There was a mortality rate in the entire group of 15.3 per cent., in the white patients of 10 per cent., and in the negro patients of 25 per cent. Of the entire group, 82.2 per cent. were either improved or recovered.

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THE TREATMENT OF LUNG ABSCESS AND EMPYÆMA BY PACKING*

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FROM THE SURGICAL SERVICE OF THE HARLEM HOSPITAL

In submitting this procedure for consideration, criticism is expected. No one has been more critical than ourselves. In general, no method of treatment in surgery produces 100 per cent. of cures. It must be realized that the method is in its infancy, and that the number of cases is comparatively small, and that changes will be made and have been made in the technic and in the selection and the preparation of cases before operation. Nevertheless, the all-round superiority of the method over other forms of treatment is unquestionable to those who have observed it.

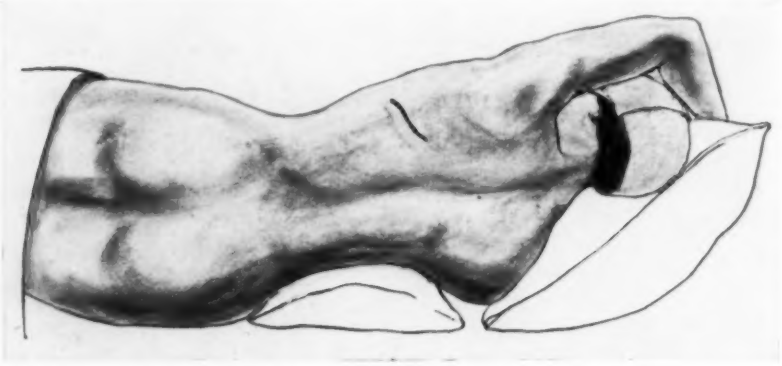


Fig. 1.—The patient is placed on the side opposite the lesion. The incision is made as illustrated above in the eighth interspace for a total empyæma, but in a case of partial empyæma the incision is made over the lesion.

The Procedure.—The patient is placed upon the unaffected side with the chest resting upon a small pillow. The arm of the affected side is drawn up over the head. (Fig. 1.) If the empyæma is localized, the incision is made at the dependent portion of the focus. If, however, the empyæma is diffuse, as is usually the case, a four-inch incision is made in the direction of the ribs along the eighth interspace in the subscapular region. About two-and-one-half inches of the eighth and ninth ribs are resected subperiosteally. The intercostal muscles and vessels are removed *en masse* from the chest-wall after being ligated for a distance corresponding to the length of the ribs resected.

An aspirating needle is inserted into the pleural cavity. If pus is obtained, a grooved director is plunged in alongside the needle. The opening is gradually enlarged until it admits the tip of the aspirating apparatus. As

* Read before the joint meeting of the Philadelphia Academy of Surgery and the New York Surgical Society, February 11, 1931.

much pus as possible is aspirated and the pleura is opened widely. At this juncture the patient occasionally coughs violently and experiences dyspnœa, but this may be controlled by closing manually the opening into the pleural cavity. The large masses of fibrin usually present are removed under vision with sponge forceps. If adhesions which form communicating intrapleural cavities exist, they are broken down in order to form one cavity. Originally, the infected and uncontaminated portions of the pleura were converted into one by manually removing the adhesions which separated them. At present, however, this method has been abandoned and uncontaminated pleura is not entered. Indeed, if, as in one case, the firm adhesions separated two pockets of pus, they are not disturbed but two separate thoracotomies are performed.

In packing the pleural cavity, iodoform gauze which has been washed and

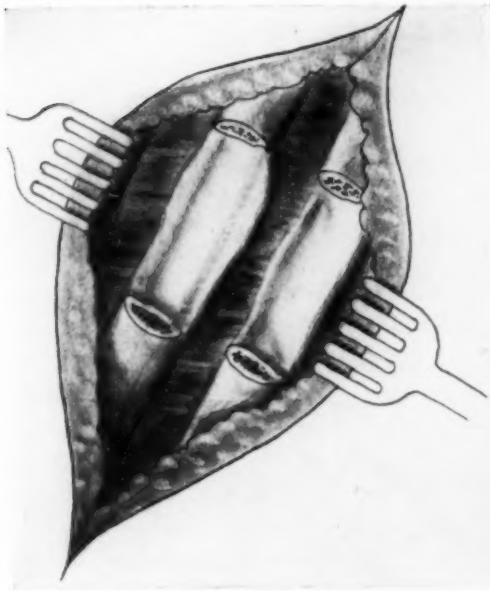


FIG. 2.—Two ribs are resected subperiosteally for a distance of about two and a half inches.

FIG. 3.—The intercostal muscles together with the intercostal vessels are ligated on either side and removed *en masse*, thus making a clear approach.

wrung out is used. With long dressing forceps it is introduced first to the apex of the cavity. It is packed tightly in this direction and also to the sulcus formed by the thoracic wall and the lung. More and more packing is introduced with the forceps and is made firmer by digital pressure. This procedure is continued until the cavity is completely filled. The skin wound is laid open wide by packing and a dry dressing is placed over it. This dressing is held in place by adhesive strappings which do not extend beyond the midline. The first case of lung abscess treated by us by the method described was done in June, 1928. The result in this case was so satisfactory, it caused us to treat all of our subsequent cases in like manner. Our first empyæma treated by this method was done April 23, 1929. The ages ranged from two to seventy-one years. Both of these cases made a complete recovery.

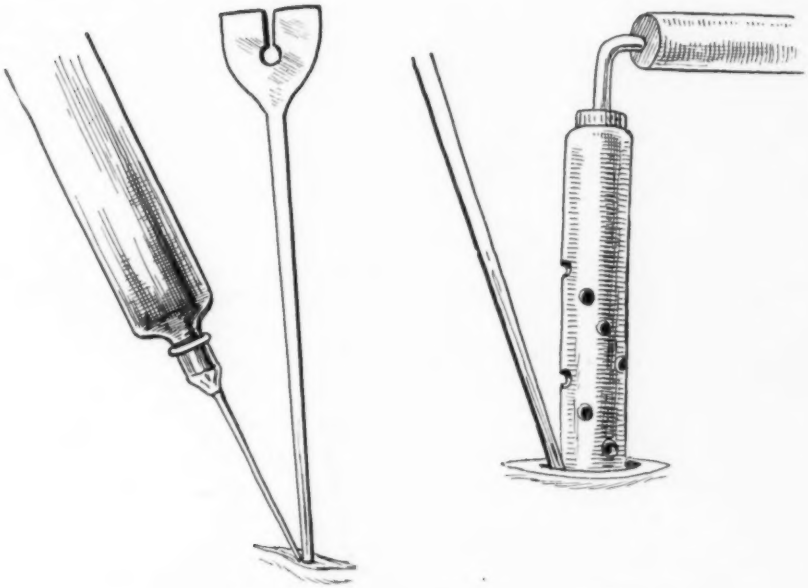
Lung Abscess.—Some cases of lung abscess are cured by postural drainage and by the use of the bronchoscope in the hands of a well-trained bronchoscopist. When it is obvious that these cases are not cured, and we believe few are, by the use of the bronchoscope, they should be submitted to surgical treatment at not too late a date. Three cases of lung abscess which had ruptured into the pleural cavity came to our attention after surgical treatment had been delayed. A case of lung abscess which had been treated by bronchoscopy developed a septicæmia with metastatic foci in the elbow, knee and ankle with various subcutaneous infections.

One of the best adjuncts to the successful surgical treatment of lung abscess has resulted from the coördination of the work of the X-ray and the medical men. Through their efforts the line of incision has almost always been definitely localized. Their work has also shown that all lung abscesses are at or very close to the periphery. The same method of tight packing with the elimination of tubes has been employed. In cases of multilocular abscess the cavity is converted into one. An empyæma has never been produced during this treatment.

Post-operative Care.—In the series presented, the packing was removed in from one to six days, although most commonly in from one to four days. Without exception the pleural surfaces, visceral and parietal, presented a smooth, clean, healthy appearance. The lung surface was pinkish and elastic. A few vigorous coughs expanded the lung to within an inch of the parietal pleura. Through the large thoracotomy wound the interesting mechanism of closure of the pleural cavity easily could be observed. Contrary to the common conception the lung on the side of the open pleural cavity expands with expiration. Coughing is the most forcible form of expiration and causes the lung to expand and fill the pleural cavity more than any other form of pulmonary exercise. The comparative inefficiency of blow bottles easily may be observed through the thoracotomy wound. Blow bottles are used continually, however, but, in addition, advantage has been taken of the observation of the value of coughing. Patients are instructed to cough every hour until tired. In the case of the type of patient found in a municipal hospital this is often difficult, but in the instances in which there is coöperation the result is encouraging.

In normal inspiration and expiration as seen through the large operative opening into the pleura the excursions of the lung are extremely small, so much so that the impression is obtained that it would be impossible to expand the lung sufficiently to fill the pleural cavity without some form of pulmonary exercise.

In addition to the effect of forced expiration another important factor in cure may be observed through the large thoracotomy wound. In packing the pleural cavity, stress is laid upon inserting the packing into the sulcus between the lung and parietal wall. Closing this sulcus is important since obliteration of the open pleural cavity starts at this point. With each dressing the sulcus



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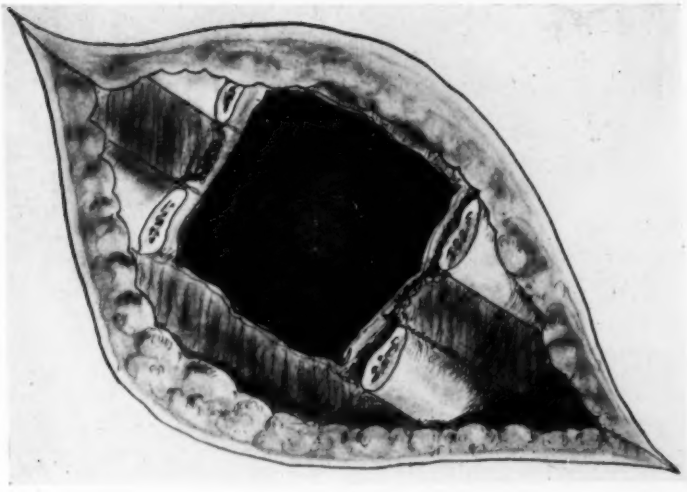

(3)

FIG. 4.—(1)—The pleural cavity is aspirated and if pus is obtained a grooved director is inserted alongside the aspirating needle. (2)—The nozzle of the aspirating apparatus is then inserted beside the grooved director, and as much pus as can be aspirated is removed. (3)—The parietal pleura is then removed, forming a large orifice. If there is any undue respiratory embarrassment, the orifice is temporarily covered with gauze. If present, all fibrinous masses are removed under vision and all the pus is aspirated. If there are mu'tilocular empyæma cavities the septa are broken down under vision.

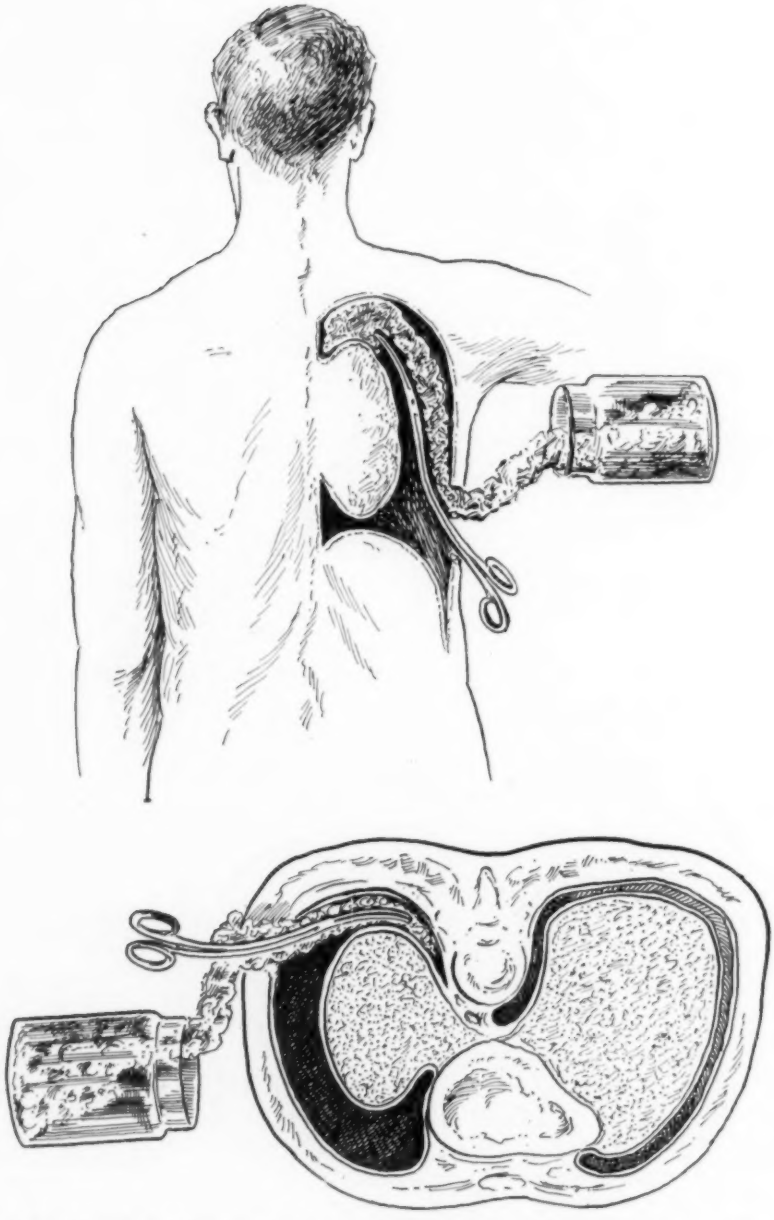

FIG. 5.—Iodoform gauze packing is then inserted, starting at the apex and proceeding downward, until the entire cavity is tightly packed.

may be seen to be more and more obliterated. With expiration the lung comes forward and seems to crawl along the parietal wall, becoming gradually adherent from the region of the mediastinum forward to the operative wound.

After the first dressing the pleural cavity is packed loosely or not at all. In the beginning many tight packings followed the first dressing. Although patients were cured in most of these cases and although the lung expanded in the presence of the frequent tight packings, it was felt that the cases in which the lung was held collapsed and firmly fixed by fibrinous membrane were due to this procedure. Four cases in which the original packing was left in for six days required secondary operations for decortication. When we speak of decortication we mean the entire fibrous membrane is completely dissected from the lung. We have found little advantage from the cross-cut method. The initial tight packing breaks down the entire pleural membrane containing bacteria, pus and fibrinous exudate. To one who for

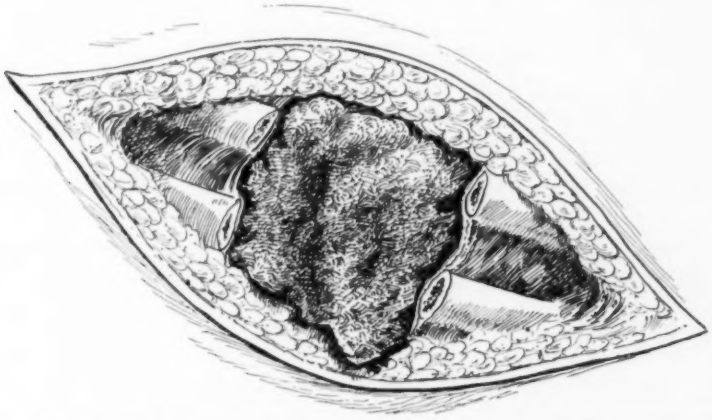

FIG. 6.—Illustrates the final step. The cavity tightly packed up to the skin incision. The skin incision is held apart by gauze packing, after vaselinized gauze has been placed on the cut surface to protect it against the pain of further manipulation.

the first time has seen the beautifully clean, pink, shiny pleura which is obtained even after twenty-four hours of tight packing, it is always a signal for wonder and approval. Thereafter, there is no further treatment of the cavity necessary—no tubes, no irrigations, no elaborate plumbing fixtures for the maintenance of drainage or irrigation. The cavity is clean and there is no more exudate than would be expected in any large clean granulating surface which now lines the pleural cavity. When one considers the pain to the patient, the trials for the surgical dresser, the constant flow of pus over a long period of time with the old method, the packing method comes as a blessing. Dressings may be changed superficially every day, and they are not painful except in the manipulation of the skin wound, and this may be avoided by the use of vaseline gauze to this part or by the insertion of broad retractors.

After the cavity has been cleaned by the tight packing, the large orifice is no longer necessary and steps may be taken to make it smaller. No fear

should be felt that this orifice will not close. As a matter of fact, toward the end of the treatment it may be found necessary to keep it open, so rapidly does granulation tissue tend to obliterate it. Probably the size of the orifice most beneficial for closure of the pleural cavity and for drainage is approximately three-fourths of an inch in diameter. This may be obtained by strapping the skin of the wound loosely or by plugging the orifice with gauze down to the pleural cavity. Although the gauze corks the mouth of the cavity it is not air-tight and allows for the flow of air in and out of the pleural cavity with movements of the lung. When the orifice tends to close before the lung is completely expanded it may be kept open by the daily insertion of the gloved finger.

In the post-operative care of the patient the administration of fluids is extremely important; by mouth and intravenously. Saline solution is usually employed. Glucose intravenously in our experience has frequently been the cause of chills. It is never used by hypodermoclysis. Transfusions have been used freely, particularly in the cases which showed varying degrees of collapse. A high-caloric diet is maintained, including plenty of whisky, especially to those who are habitual drinkers. The patient is propped up in bed but is gotten out as soon as his condition allows and is urged to move about and sit out-of-doors when the weather permits.

A Consideration of Deaths Following Operation.—The ages at death were: Two, three, six, eighteen, twenty, twenty-three, twenty-nine, thirty-eight, forty and forty-two years of age. It will be observed that there were no deaths in patients of advanced age.

Two patients who died had a chronic active pulmonary tuberculosis and died of shock and cardiac failure, respectively four and fifteen days after operation. At the time of death the pleural cavities were clean.

Three patients who died had a bacteræmia before operation. Two of these were complicated cases. One had a subphrenic abscess which communicated with the empyæma cavity. The empyæma was probably secondary and a later manifestation of the subphrenic infection. Another was admitted with a diagnosis of gangrene of the leg and bronchitis. The dorsum of the foot and the leg was the seat of a deep infection and was bathed in pus of the extremely foul-smelling type, characteristic of lung abscess. There was an abscess over the tibia which contained gas and the same ill-smelling pus. Fluid developed in the pleural cavity, which, clear at first, became thick and more foul. This was also characteristic of the pus found in lung abscesses. Whether the so-called bronchitis found on admission was really a long-standing lung abscess and the leg infection a metastasis from it, or whether the lung changes were secondary to the leg infection was not determined. The patient went on to rapid termination presenting at all times the picture of marked sepsis.

One patient had a necrosis with sloughing of the entire middle lobe of the lung and collapse of the lower lobe on the right side. The packing completely cleaned up the necrosed lobe and the accompanying empyæma in four

days but the patient succumbed to a pneumonic process involving the entire left side. He had only his right upper lobe for breathing and the poor

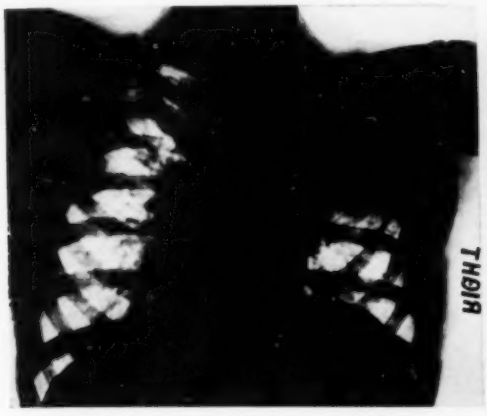

FIG. 7.—Albert W. Showing the diffuse shadow of a pneumonitis over the right upper lobe. Patient extremely sick with lung abscess of unknown origin. April 28, 1930.

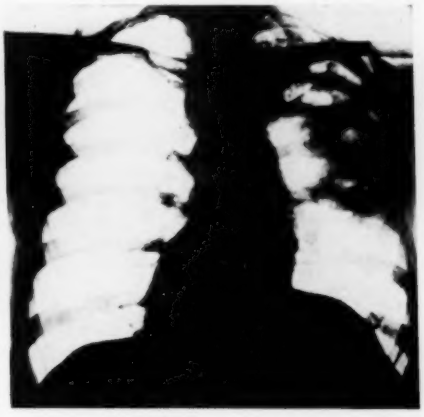

FIG. 8.—Albert W. Partial subsidence of pneumonitis revealing multilocular pulmonary abscess. May 26, 1930.

aëration coupled with the toxæmia of the pneumonic process was too much for him.

One patient died on the table from spinal anæsthesia.

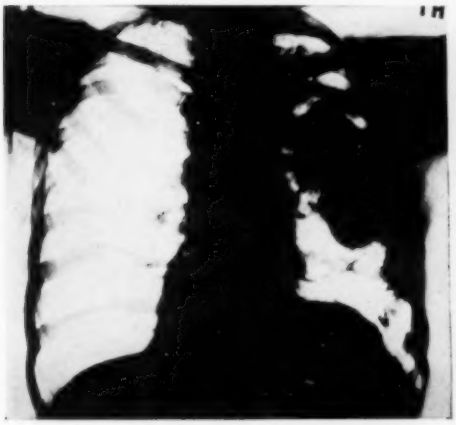

FIG. 9.—Albert W. The dense shadow represents the iodoform gauze packing which was introduced into the cavity in the lung after the multilocular abscess was made into one cavity by breaking down the many septa. July 14, 1930.

FIG. 10.—Albert W. The iodoform gauze packing has been removed. There is some fibrosis, but no pneumonitis. The patient is free of cough and expectoration. November 26, 1930.

One patient died of toxæmia fourteen days post-operatively and another twenty-two days post-operatively of toxæmia and enteritis.

And finally the child of two years died seventy-one days post-operatively, gradually petering out.

What are the lessons to be gained from the consideration of these deaths? In the series of forty cases there were three patients with pre-operative septicæmia and all three died. There were four patients with pulmonary tubercu-

losis, of whom two died. (Unfortunately it is not recorded whether or not the empyæmata were tuberculous.)

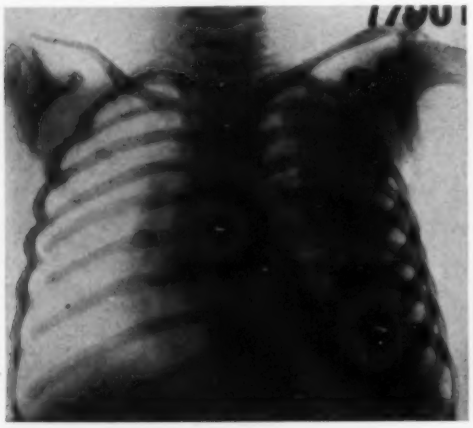

FIG. 11.

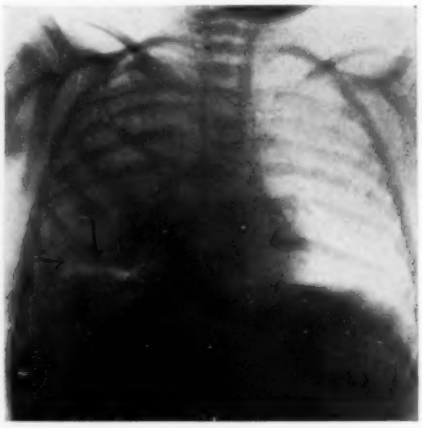

FIG. 12.

FIG. 11.—William C. A case of postpneumonic empyæma. There is a diffuse shadow over the left lung. Thick pus was aspirated in the eighth interspace, posteriorly, below the scapula, and operation was performed at this point. A small, localized empyæma was found and treated by packing. October 16, 1930.

FIG. 12.—William C. The small light area at the base indicates the small localized empyæma evacuated at the first operation, but reveals the diffuse shadow above it. Accordingly, another operation was performed to evacuate this empyæma which was separated from the one below it and the packing treatment was instituted. A second operation was considered preferable to breaking down the septum between the cavities because in the lower one the lung had already expanded, filling the cavity. October 27, 1930.

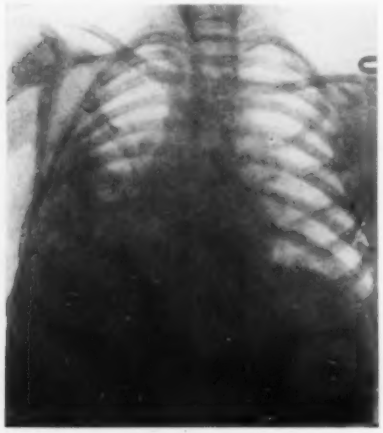

FIG. 13.

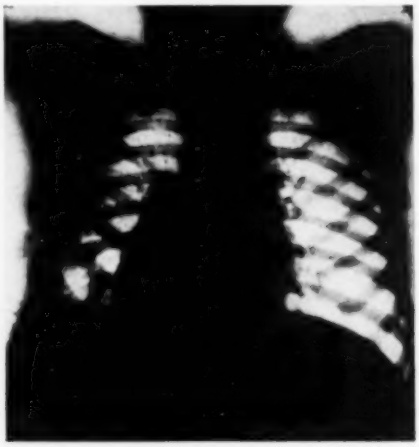

FIG. 14.

FIG. 13.—William C. The upper portion of the left chest is clear while the lower portion shows the shadow of thickened pleura. The gauze has been removed from both cavities and the lung has completely expanded. November 13, 1930.

FIG. 14.—William C. The wounds are closed, granulating. There is still some thickened pleura. November 22, 1930.

Even though the packing method is considered the best at our disposal, some of the deaths seem to indicate that it should not be immediately applied to all cases without due consideration. Probably the method of approach to these few cases should be changed. Perhaps in the case of those extremely sick patients they may be tided over by frequent aspirations of pus and then

finally when improved operated upon by thoracotomy and packing. This applies also to those patients who, prior to operation, are in varying degrees of cardiac collapse with pallor, cyanosis and weakness, and who are cold and clammy. Temporizing and supportive treatment may be indicated before thoracotomy.

The death from spinal anæsthesia merely accentuates the fact that it should not be used in pulmonary diseases since it has a particular affinity for the respiratory centre.

With regard to the relation of death to bacteriologic findings in the pus obtained from the empyæmata, the number of cases is probably too small for conclusions. Thus far, there seems to be no relation between the number of deaths and any given type of bacteria isolated from the pus. In no case was operation undertaken before the pus aspirated was thick. Pus and fibrin disappeared under this treatment very rapidly whatever the type of infection may have been.

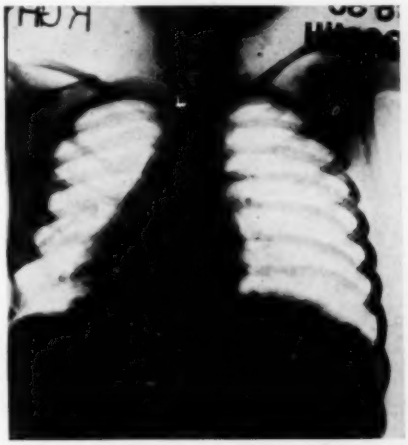

Fig. 15.—William C. Wounds entirely healed. Lung clear except for slight thickening of pleura visible at periphery. December 6, 1930.

Table of Packed Empyæma and Lung Abscess Cases

Case I.—E. F., white, male, aged thirty-seven years. Days ill before operation—Sixteen. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—I. Anæsthesia.—Gas-oxygen. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Four. Days of elevated temperature post-operative.—Thirty-seven. Days in bed post-operative.—Thirty-nine. Days in hospital post-operative.—Forty-four. Remarks.—Discharged healed. Condition good one and one-half years later.

Case II.—M. H., white, male, aged seventy-one years. Days ill before operation.—Thirty-four. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—V. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Four. Days of elevated temperature post-operative.—Four. Days in bed post-operative.—Twenty-two. Days in hospital post-operative.—Forty-seven. Remarks.—Discharged healed. Condition good six months later.

Case III.—J. B., colored, male, aged twenty-one years. Days ill before operation.—Twenty-one. Admission diagnosis.—Lobar pneumonia. Anæsthesia.—Local. Bacteriology of chest fluid.—Staphylococcus. Number of packings.—Four. Days of elevated temperature post-operative.—Ten. Days in bed post-operative.—Twelve. Days in hospital post-operative.—Twenty-six. Remarks.—Allowed to close too soon. Reopened. Discharged with wound open. Clinic treatment. Seen six months later.

Case IV.—L.V., white, male, aged twenty-seven years. Days ill before operation.—Twenty-nine. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—I. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Six. Days of elevated temperature post-operative.—Nine. Days in bed post-operative.—Twelve. Days in hospital post-operative.—Twenty-one. Remarks.—Had second operation one month later. No pus found; only fibrous tissue. Mistaken diagnosis.

Case V.—A. Q., colored, male, aged twenty-eight years. Days ill before operation.—.? Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—I. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Nine. Days of elevated temperature post-operative.—Thirteen. Days in bed post-operative.—Seventeen. Remarks.—Discharged healed.

Case VI.—C. P., colored, male, aged twenty-nine years. Days ill before operation.—One year. Admission diagnosis.—Chronic empyæma. Anæsthesia.—Local. Bacteriology of chest fluid.—?. Number of packings.—Eleven. Days of elevated temperature post-operative.—Eleven. Days in bed post-operative.—Twelve. Remarks.—Healing slow. End-result good. Seen one year later.

Case VII.—C. H., colored, male, aged twenty-four years. Days ill before operation.—Forty-one. Admission diagnosis.—Lobar pneumonia. Type of pneumonia cases.—?. Anæsthesia.—Local. Bacteriology of chest fluid.—Streptococcus and staphylococcus. Number of packings.—Five. Days of elevated temperature post-operative.—Fourteen.

Fig. 16.—Eugene F. A case of postpneumonic empyæma, showing the shadow obscuring almost the entire right lung. April 23, 1929. Patient was treated by thoracotomy and packing of the entire pleural cavity.

Fig. 17.—Eugene F. Condition, May 6, 1929, shows slight pleural thickening but no fluid in the pleural cavity which was clean. The large thoracotomy wound tended to close so rapidly that it was necessary to place a tube down to but not into the pleural cavity.

Days in bed post-operative.—Sixteen. Days in hospital.—Twenty. Remarks.—Discharged healed.

Case VIII.—J. H., colored, male, aged thirty-three years. Days ill before operation.—Twelve. Admission diagnosis. Acute pleurisy. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—One. Days of elevated temperature post-operative.—Five. Days in bed post-operative.—Five. Days in hospital post-operative.—Thirteen. Remarks.—Pockets not broken down. Drainage difficult. Packing unsatisfactory unless pockets removed. Discharged healed.

Case IX.—H. F., colored, male, aged forty-two years. Days ill before operation.—Twenty. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—IV. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Five. Days of elevated temperature post-operative.—Twenty-one. Days in bed post-operative.—Twenty-two. Days in hospital post-operative.—Twenty-four. Remarks.—Discharged healed.

Case X.—R. K., colored, female, aged forty-two years. Days ill before operation.—Thirty-one. Admission diagnosis.—Pulmonary tuberculosis. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Four. Days of elevated temperature post-operative.—Three. Days in bed post-operative.—Fifteen. Days

in hospital post-operative.—Fifteen. Day of death post-operative.—Fifteen. Remarks.—Recovery satisfactory to thirteenth day. Wound clean. Death attributed to cardiac failure.

CASE XI.—M. B., colored, male, aged twenty-nine years. Days ill before operation.—Forty-two. Admission diagnosis.—Pulmonary tuberculosis. Anæsthesia.—Gas-oxygen. Bacteriology of chest fluid.—?. Number of packings.—One. Day of death post-operative.—Fourth day. Remarks.—Operative death. Tuberculosis cases not suited for this type of treatment.

CASE XII.—M. A., colored, male, three years. Days ill before operation.—Twenty-four. Admission diagnosis.—Lobar pneumonia. Type in pneumonia cases.—?. Anæsthesia.—Ether. Bacteriology of chest fluid.—Staphylococcus and streptococcus. Number of packings.—Eight. Day of death post-operative.—Twenty-second day. Remarks.—Condition poor at time of operation. Developed severe diarrhœa with dehydration.

CASE XIII.—V. B., colored, female, aged twenty years. Days ill before operation.—Twenty-two. Admission diagnosis.—Lobar pneumonia. Type of pneumonia cases.—?. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—One. Day of death post-operative.—Second day. Remarks.—Had septicæmia on admission. Subphrenic abscess connecting with pleural cavity. Complicated empyæma.

CASE XIV.—C. M., white, male, aged twenty-nine years. Days ill before operation.—Twenty-eight. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—III. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Twenty-four. Days of elevated temperature post-operative.—Twenty. Days in bed post-operative.—Twenty-one. Days in hospital post-operative.—Sixty-five. Remarks.—Packed too many times. Wound not completely healed when discharged from ward.

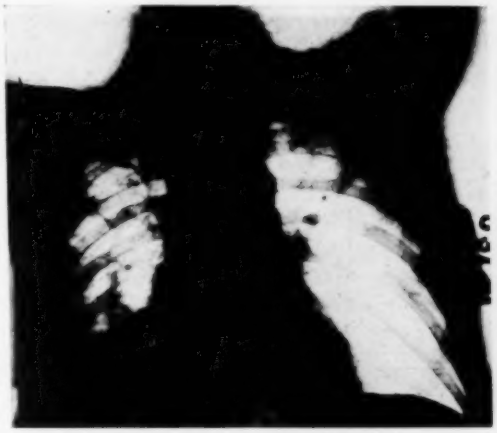

FIG. 18.—Eugene F. The wound has healed, there is no pneumothorax and no fluid. The patient is entirely cured. May 31, 1930.

CASE XV.—G. S., colored, male, aged twenty-eight years. Days ill before operation.—Eighteen. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—II. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Eight. Days of elevated temperature post-operative.—Twenty. Days in bed post-operative.—Twenty-one. Days in hospital post-operative.—Fifty-three. Remarks.—Discharged cured.

CASE XVI.—C. B., colored, male, aged forty years. Days ill before operation.—Thirty-five. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—XX. Anæsthesia.—Local. Bacteriology of chest fluid.—Streptococcus. Number of packings.—Three. Days of elevated temperature post-operative.—Five. Days in bed post-operative.—Sixteen. Days in hospital post-operative.—Twenty. Remarks.—Discharged in good condition but with wound not quite healed. Healed when seen two weeks later.

CASE XVII.—A. C., white, male, aged twenty-three years. Days ill before operation.—Sixteen. Admission diagnosis.—Lobar pneumonia. Type in pneumonia cases.—?. Anæsthesia.—Local. Bacteriology of chest fluid.—?. Number of packings.—Five. Day of death post-operative.—Fourteenth day. Remarks.—Had bronchial fistula.

CASE XVIII.—J. S., colored, male, aged thirty-four years. Days ill before operation.—Twenty-one. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—II. Anæsthesia.—Ether. Bacteriology of chest fluid.—Pneumococcus. Number of

packings.—Fourteen. Days of elevated temperature post-operative.—Eleven. Days in bed post-operative.—Fifteen. Days in hospital post-operative.—Sixty-five. Remarks.—Recovery slow. Wound open at time of discharge. Follow-up clinic reported closure in a few weeks.

CASE XIX.—O. R., white, male, aged fourteen years. Days ill before operation.—

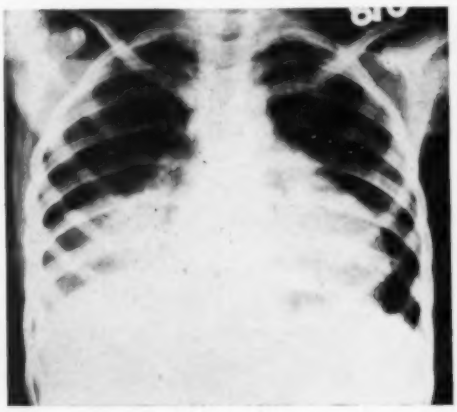

FIG. 19.

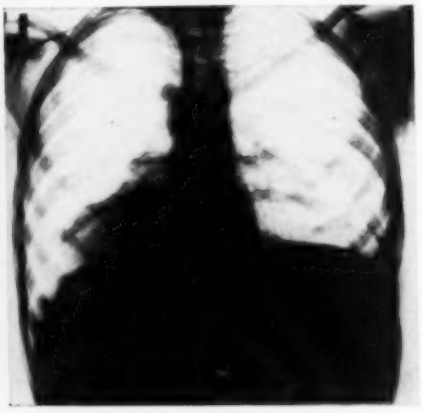

FIG. 20.

FIG. 19.—Althea H. A postpneumonic empyæma in an emaciated child, treated by thoracotomy and packing of the entire pleural cavity with iodoform gauze. Although the picture demonstrates a shadow over the lower right lobe, with the patient in the erect position, operation revealed pus throughout the entire pleural cavity. January 21, 1931.
FIG. 20.—Althea H. Eighteen days after operation there was no pneumothorax, the wound was closed and granulating. The patient was cured. February 9, 1931.

Twenty-five. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—I. Anæsthesia.—Gas oxygen. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Twenty-seven. Days of elevated temperature post-operative.—Twenty-nine. Days in bed post-operative.—Twenty-five. Days in hospital post-operative.—Seventy-

FIG. 21.

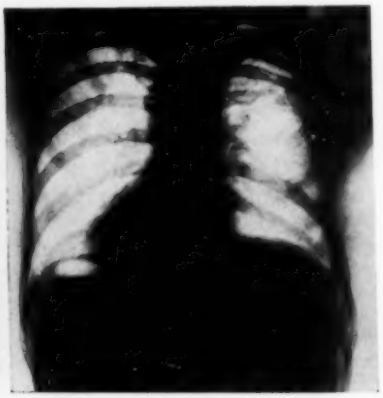

FIG. 22.

FIG. 21.—Bert P. A postpneumonic empyæma of the right pleura, multilocular in type. All septa were broken down and the entire pleural cavity packed tightly and frequently with iodoform gauze. Although the pleural cavity was kept clean a thick fibrinous exudate formed which necessitated decortication to allow for expansion of the lung which it held immobile. September 4, 1930.
FIG. 22.—Bert P. Final result. There is no thickening of pleura, no pneumothorax, and the wound is firmly healed. January 13, 1931. The patient is cured.

one. Remarks.—End-result good. Packed too many times. Retards recovery and tends to prevent lung expansion.

CASE XX.—V. H., colored, male, aged eighteen years. Days ill before operation.—?. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—?. Anæsthesia.—

Local. Bacteriology of chest fluid.—Staphylococcus. Number of packings.—?. Day of death post-operative.—Twenty-fifth day. Remarks.—Staphylococcus septicæmia.

CASE XXI.—W. M., white male, aged twenty-six years. Days ill before operation.—Four years. Admission diagnosis.—Chronic empyæma. Anæsthesia.—Spinal. Bacteriology of chest fluid.—?. Number of packings.—Twenty. Days of elevated temperature post-operative.—Seven. Days in bed post-operative.—Forty-five. Days in hospital post-operative.—Fifty-one. Remarks.—Results in cases of chronic empyæma unsatisfactory. Pleura almost one inch thick around cavity.

CASE XXII.—H. M., white, male, aged eighteen years. Days ill before operation.—Nineteen. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—XIII. Anæsthesia.—Spinal. Bacteriology of chest fluid.—No growth. Number of packings.—Fifteen. Days of elevated temperature.—Twenty-nine. Days in bed post-operative.—Thirty-three. Days in hospital post-operative.—Seventy-one. Day of death post-operative.—Seventy-third day on which day a secondary operation for decortication of lung was performed. Remarks.—Death attributed to spinal anæsthesia at secondary operation. Original packing remained in too long. Lung failed to expand.

CASE XXIII.—A. L., colored, male, aged twenty-eight years. Days ill before operation.—Six. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—I. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—?. Days of elevated temperature post-operative.—Sixty-four. Days in bed post-operative.—Seventy-two. Days in hospital post-operative.—One hundred and forty-nine. Day of death post-operative.—One hundred and sixty-first day. Remarks.—Death at second secondary operation. Original packing in too long. Lung becomes covered with fibrous tissue. Decortication necessary.

CASE XXIV.—J. C., colored, male, aged thirty years. Days ill before operation.—Twenty-four. Admission diagnosis.—Pleural effusion. Anæsthesia.—Ether. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—One. Days of elevated temperature post-operative.—Fifteen. Days in bed post-operative.—Eighteen. Days in hospital post-operative.—Twenty-five. Remarks.—Result satisfactory. Packed only once.

CASE XXV.—B. P., colored, male, aged thirty-five years. Days ill before operation.—Twenty-nine. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—III. Anæsthesia.—Avertin. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Six. Days of elevated temperature post-operative.—Thirty-two. Days in bed post-operative.—?. Days in hospital post-operative.—Forty-nine. Remarks.—First packing in too long. Required secondary operation for decortication of lung.

CASE XXVI.—J. C., colored, female, aged eighteen years. Days ill before operation.—?. Admission diagnosis.—Chronic empyæma. Anæsthesia.—Local. Bacteriology of chest fluid.—Streptococcus. Number of packings.—?. Days of elevated temperature post-operative.—Twenty-one. Days in bed post-operative.—Sixteen. Days in hospital post-operative.—One hundred and twenty-six. Remarks.—Case of chronic empyæma with discharging sinus under breast, healed seven months later.

CASE XXVII.—J. McN., white, male, aged thirty-eight years. Days ill before operation.—Sixteen. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—?. Anæsthesia.—Ether. Bacteriology of chest fluid.—Gram-negative gas bacillus. Number of packings.—Four. Day of death post-operative.—Eleventh day. Remarks.—Bronchial fistula and gangrene of lung due to a Gram-negative gas bacillus. Identity not determined.

CASE XXVIII.—M. P., white, female, aged forty years. Days ill before operation.—?. Admission diagnosis.—Gangrene of leg. Suppurative pleurisy. Anæsthesia.—Ether. Bacteriology of chest fluid.—Pneumococcus and staphylococcus. Number of packings.—One. Day of death post-operative.—Same day. Remarks.—Condition very poor on admission. Staphylococcus septicæmia. Gangrene of leg.

CASE XXIX.—W. C., colored, male, aged five years. Days ill before opera-

tion.—Sixteen. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—?. Anæsthesia.—Ether. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Three. Days of elevated temperature post-operative.—Eight. Days in bed post-operative.—Nine. Remarks.—Had two operations for two distinct pus cavities. Results excellent.

Case XXX.—E. G., colored, female, aged six years. Days ill before operation.—Thirty. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—?. Anæsthesia.—Spinal. Bacteriology of chest fluid.—No growth. Number of packings.—One. Day of death post-operative.—Same day. Remarks.—Death attributed to overdose of novocaine.

Case XXXI.—J. G., colored, male, aged two years. Days ill before operation.—Twenty-two. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—IV. Anæsthesia.—Ether. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—?. Day of death post-operative.—Seventy-first day. Remarks.—Bronchial fistula. Convalescence never satisfactory.

Case XXXII.—P. P., white, male, aged two years. Days ill before operation.—Fourteen. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—I. Anæsthesia.—Ether. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Eleven. Days of elevated temperature post-operative.—Sixteen. Days in bed post-operative.—Fifty-three. Days in hospital post-operative.—Sixty-five. Remarks.—Discharged healed.

Case XXXIII.—R. M., colored, male, aged two years. Days ill before operation.—Thirty-one. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—I. Anæsthesia.—Gas-oxygen. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—Forty-four. Days of elevated temperature post-operative.—Five. Days in bed post-operative.—Eleven. Days in hospital post-operative.—One hundred and forty-one. Remarks.—Packed too many times. End-result good.

Case XXXIV.—R. J., colored, male, aged thirty-five years. Days ill before operation.—Thirty-two. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—VII. Anæsthesia.—Local. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—?. Days of elevated temperature post-operative.—Twenty-seven. Days in bed post-operative.—Thirty-six. Days in hospital post-operative.—One hundred and nine. Remarks.—Too many packings. Wound unhealed on discharge, but now entirely healed.

Case XXXV.—P. T., colored, male, aged thirty-five years. Days ill before operation.—Fifteen. Admission diagnosis.—Lobar pneumonia. Type of pneumonia.—X and XVIII. Anæsthesia.—Ether. Bacteriology of chest fluid.—Pneumococcus. Number of packings.—?. Days of elevated temperature post-operative.—Twenty-four. Days in bed post-operative.—Twenty-seven. Days in hospital post-operative.—Seventy. Remarks.—Ruptured lung abscess present. Recovery slow. Condition good.

What Are the Objections to the Operation?—In the beginning, four chronic sinuses resulted, due to the too tight packing and to invasion of uncontaminated pleura. This has been eliminated, it is believed, by the use of only one tight packing and by nondestruction of the adhesions. In several cases it was observed that the pulse was accelerated by twenty or more beats per minute, by the use of the tight packing. This was particularly true when the packing was applied with some pressure to the region of the base of the heart. In each instance, release of the pressure of the packing allowed the heart to beat more slowly. The most interesting patient in this connection was R. J., who had an empyæma localized entirely on the left side. In the X-ray picture it was impossible to differentiate the shadow of this empyæma from that of a pericardial effusion. An anterior incision

was made in the left parasternal line at the base of the heart and packing was applied tightly, and contrary to our present custom re-applied tightly at intervals. Each time the packing accelerated the heart-beat and caused distress, and each time it was relieved by removing the packing, which was, therefore, discontinued. The patient was cured. This objection is overcome by the use of only one tight packing.

The existence of another infection, whether chronic or acute, in the opposite lung may be considered a contra-indication to the use of the packing method but it is disadvantageous also for treatment by any other method.

The Advantages of the Packing Method.—1. The pleural cavity is cleaned within twenty-four hours and remains grossly clean until the cure is effected. This phenomenon is so striking that it is difficult for the uninitiated to believe it possible until it is seen.

2. The ease of management post-operatively by the surgeon. By the old method change of dressings daily or twice daily was necessary or else extensive apparatuses were employed. Even with the simpler procedures close attention to details was necessary. By this method dressings are changed at comparatively infrequent intervals and may even be forgotten for several days.

3. The introduction of tubes is unnecessary, and, therefore, a source of pleural irritation is removed. It is well known that drainage will continue as long as a tube is allowed to remain in a sinus. It is also noteworthy that no case of osteomyelitis of the rib developed in the cases since there was no tube to rub for days against a rib adjacent to the thoracotomy wound.

4. It prevents the discomfort which may be due to a mobile mediastinum by fixing it. In several cases when the tight packing was removed discomfort was experienced which was relieved by the re-insertion of the packing.

5. The large thoracotomy wound with the help of the Cameron light permits of a perfect inspection of the pleural cavity and allows the operator to remove all fibrin and break up the necessary adhesions and pockets. And not least interesting it has allowed a clear view of the mechanism of the cure of the empyæma cavity and has helped improve the methods directed toward cure.

Discussion: Dr. John B. Flick (Philadelphia) said that Doctor Connors' method of treatment as a routine measure seems too radical. It does not appear to be justified in the ordinary case of empyæma which, with proper drainage, heals promptly. The speaker also agreed with Paget that there is some danger in the use of iodoform gauze.

For the past ten years Doctor Flick has practiced irrigation of the empyæma cavity in adults with Dakin's solution and has been well satisfied with the results. He has usually resected a portion of the eighth or ninth rib just lateral to its angle, removed the fibrin as well as possible, sutured in place a double-barreled rubber tube and twenty-four or forty-eight hours later, commenced irrigations. He has never found it necessary to break down

adhesions. He depended upon aspiration to tide the patient over until the collection of pus was localized.

Doctor Flick felt that the bronchoscopic treatment of pulmonary abscess, in the hands of an expert, is of real value. Louis H. Clerf recently reported a brief summary of the results of treatment in a series of seventy-seven cases of pulmonary abscess following tonsillectomy. Thirty-eight of these patients were ultimately discharged as well after a course of bronchoscopic treatment. It is, of course, obvious that the earlier the treatment is instituted, the better the prospect for cure and that conservative treatment should not be continued for too long a period of time if a cure is not forthcoming.

In 1926, J. A. Miller and A. V. S. Lambert called attention to the fact that external drainage does not drain the pneumonic process about the central suppurating focus which is present during the acute phase of pulmonary abscess, and that with the establishment of a free opening, the effectiveness of coughing to empty these areas is greatly reduced. This had been the speaker's own experience and he was then packing pulmonary abscesses firmly with gauze in order to remedy this difficulty. At first he used iodoform, but gradually drifted to the use of plain gauze.

Dr. George D. Stewart said he was satisfied that this treatment of empyæma as developed by Doctor Connors is founded on sound surgical principles. He agreed with Doctor Flick that it was not applicable or necessary to use such a radical procedure in all empyæma cases; it is frequently only necessary to take out a little bit of rib and follow this with drainage and symptomatic treatment.

THE FUNCTION OF THE LIVER IN RELATION TO SURGICAL PROCEDURES*†

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In a series of studies on the relative merits of the various tests of hepatic function carried out in the clinic several years ago, the test which seemed to give evidence of real value in certain diseases of the liver was the Rowntree-Rosenthal method of determining the ability of the liver to excrete one of the phthaleins. Time and experience have changed these views only slightly, which might be summarized by the statement that there is retention of the dye in the blood-stream in cases of cirrhosis of the liver and in cases of metastatic carcinoma of the liver.[5, 6] Two cases are illustrative.

In one case the patient was in the carcinoma age, there was a history of pyloric obstruction confirmed by the Röntgen-ray, a slight degree of jaundice, and a palpable epigastric mass seemingly attached to an enlarged liver. The possibility of a metastatic malignant lesion in the liver was considered. The Rowntree-Rosenthal test of hepatic function did not show retention of dye in the blood-stream. Abdominal exploration revealed the obstruction to be the result of a perforated gall-bladder whose ejected contents, which had been encapsulated by the omentum and stomach, produced the palpable mass with its obstructive features.

In the hospital at the present time is a patient who has had abdominal paracentesis because of ascites. Her general condition has been satisfactory. The absence of definitely palpable pelvic lesions had led to the erroneous diagnosis of biliary cirrhosis. The Rowntree-Rosenthal test was negative; in other words, there was no retention of the dye in the blood. When paracentesis was performed a small exploratory incision was made revealing a normal liver but diffuse pelvic carcinomatosis, the result of papillary carcinoma of the right ovary. A Talma-Morison operation in this case would have been without benefit. On the other hand, Röntgen-ray treatment following hysterectomy, if the papillary lesions are localized, has been followed by very good results in such cases due to the apparent marked radioactivity of this type of malignant cell.

In cases of biliary obstruction, the degree of jaundice, best measured by the amount of bile pigment in the blood-stream (van den Bergh reaction) gives some information regarding hepatic function. It may be said in general that a sustained serum bilirubin of more than 15 milligrams means that the hepatic cells have undergone considerable injury. This is especially true if in addition there is unusually prolonged coagulation time or the presence of subcutaneous petechiæ or hæmorrhages. In some such cases, at operation, the deep greenish hue of the liver, with the lobules standing out as punctate, yellowish spots, is a danger signal. I have seen a few cases of this type in which the patients failed to recover, even though the removal of a stone or

* Read before the Seattle Surgical Society, February 6, 1931.

† Submitted for publication February 17, 1931.

stones from the common bile duct causing the obstruction was carried out with ease, but in spite of every effort to control hepatic toxæmia, including blood transfusions and injections of glucose both before and after operation, the patient failed to recover. The corollary of this is that gall-stones should be removed before jaundice appears. It should be emphasized that if jaundice does occur, the patient should be placed immediately under a clinician's and surgeon's care to determine whether the obstruction is intrahepatic or extrahepatic and if the latter to determine the propitious time for operation, in order that the prolonged effects of biliary obstruction may not menace the patient's life.

The constituents of drainage from the biliary passages, after an operation, afford valuable information concerning the function of the liver. Last year, Greene, Fredrickson and I[4, 13] studied the composition of the bile following the relief of biliary obstruction in nine cases. These cases were equally divided into three groups in which the obstruction was due (1) to stone in the common bile-duct, (2) to carcinoma at the head of the pancreas, and (3) obstructive jaundice due to cholangitis, associated with biliary cirrhosis. The output of the bile pigment (bilirubin), of the bile acids, of the urea and of the chlorides was studied. The concentration of bile acids was regarded to be of considerable significance in that if the hepatic cells did not function properly, the bile acids were late in appearing and remained at a low level. The total amount of bile pigment, however, in all three groups, remained almost constant with the exception that its concentration varied inversely with the volume of the bile, that is, the lesser the amount of the bile, the greater the amount of the bile pigments and *vice versa*. The concentration of urea in the bile varied directly with that in the blood. Ordinarily this pathway of elimination is not significant but in one case there was considerable loss of urea through the fistula.

The quantity of bile drained in the cases of stone in the common bile-duct averaged approximately 500 to 700 cubic centimetres in twenty-four hours. In contrast, in the cases of carcinoma of the pancreas producing obstruction, the approximate average output of bile in twenty-four hours was 1,300 cubic centimetres and on some occasions it was as much as 2,000 cubic centimetres. The significance of this tremendous loss of fluid must not be underestimated, especially since analysis of the bile showed that approximately ten times as much sodium chloride was lost from the tissues of the body through this biliary drainage as was lost in the cases in which the obstruction was due to stone. This is probably the reason that an external biliary fistula in such cases usually terminates the patient's life. Explanation for this large biliary output is better understood by a study of Counseller and McIndoe's[2] celloidin and corrosion specimens of the biliary passages. When a stone in the common bile-duct is the cause of the jaundice, there is associated infection in the common bile-duct, the hepatic bile-ducts and their branches within the liver. Such intrahepatic infection in the walls of these ducts probably prevents their dilatation. This may be noted in the change in the color of the common

bile-duct from bluish-green to whitish, and the thickening of its walls, conditions practically never lacking if a stone exists in the duct. If the obstructive jaundice is due to a tumor at the head of the pancreas, even though there may be enormous dilatation of the common and hepatic bile-ducts and the gall-bladder, little change is noted in color or in thickness of the walls.

Celloidin and corrosion specimens from cases of carcinoma of the pancreas show tremendous dilatation of the intrahepatic bile ducts. It may be assumed that the increase of the amount of fluid discharged from the bile passages in such cases is a result of the increased surface area of the ducts. The practical significance of this study is that the quantity and color of bile drainage may explain the toxæmia in cases of these types and it should emphasize the necessity of maintaining a greater fluid intake than output and the necessity of a return to the tissues of sodium chloride, lost through excessive biliary drainage, lest dehydration toxæmia occur.

There is difference of opinion regarding the influence of cirrhosis of the liver on operative mortality. In my experience, if the cirrhosis has existed even to a considerable degree in association with a diseased gall-bladder with gall-stones or stones in the common bile-duct, the risk of operation is not appreciably more than in cases in which a minimal amount of cirrhosis exists. I have not hesitated to operate in such cases, provided the general condition of the patients is otherwise satisfactory. The rationale for this lies in the fact that there is accumulating evidence that such cholecystitis is significant in the development and continuation of the cirrhosis and perhaps in the prevention of regeneration of liver.

Not enough emphasis has been placed on the tendency of the liver to regenerate. It has been repeatedly demonstrated by Mann and his coworkers[7, 3] that following the removal of as much as four-fifths of a dog's liver, regeneration of an amount equivalent to that removed will take place in approximately six weeks. Further, Bollman has found that animals in which cirrhosis of the liver has been produced experimentally, can be kept free from ascites on a carbohydrate diet composed basically of corn syrup, and that ascites immediately appears with the feeding of a concentrated meat extract.

I have seen a few cases of marked cirrhosis of the liver secondary to biliary obstruction, in which there was clinical evidence of regeneration of the liver. In one case of a diseased gall-bladder and a large stone in the common bile-duct the cirrhotic liver had produced considerable ascites. Following the removal of the diseased gall-bladder and the stone it was necessary to control the ascites with one of the mercurial diuretics combined with ammonium chloride. Three months later, during which time the patient had been on a high carbohydrate diet, the diuretics were discontinued without the reformation of ascites. This patient was operated on two and a half years ago and in a recent letter from her, she reported that she was feeling very well, and has not had further biliary colic, jaundice or accumulation of fluid in the abdomen.

In another case I performed anastomosis between the gall-bladder and

duodenum in 1926 for the relief of a stricture of the lower end of the common bile-duct. The patient had been in bed for almost a year prior to operation. Subsequent to operation, although recovery was slow, the patient was able to return to part of her household duties within a few months. During the next year, improvement was slow; at times transient jaundice occurred, lasting a few days, without fever or pain. During the succeeding year these periods of jaundice became fewer and shorter in duration, and the next year she returned to the clinic for examination. She was found to be in good condition. There was approximately 1 milligram of bilirubin in the blood serum and there was no ascites or evidence of jaundice of the skin or sclera. She furthermore stated that she had enjoyed good health during the year.

Additional problems in the treatment of patients with cirrhosis of the liver have been the study and application of methods directed to the prevention of fatal intestinal hæmorrhages, usually from bleeding varices of the œsophagus. McIndoe, in his dissections of these varices and their tributaries, has shown that venous blood obstructed by a cirrhotic liver causes varices of the œsophagus due to the extensive collateral circulation between the left coronary vein lying in the gastrohepatic omentum along the lesser curvature of the stomach and the branches of the internal mammary vein. Rowntree proposed that ligation and division of the branches of the left coronary vein be done, hoping thus to reduce the amount of blood passing through the varices from the coronary veins to the internal mammary veins. This has been done in four cases[8, 9, 14] at the clinic, with temporary relief of the bleeding; in one case relief was obtained for more than a year. The procedure was combined with splenectomy in two cases and further hæmorrhage did not occur. It is too early to evaluate the effect of ligation of the coronary veins; too few cases have been observed to allow one to formulate an opinion. In two cases in which successful total gastrectomy was done recently for extensive carcinoma,[10, 12] excellent exposure of the lower end of the œsophagus was attained by the use of a left rectus incision and under spinal anæsthesia. The appearance of the lower end of the œsophagus in these cases leads me to believe that possibly the coronary veins have not been ligated high enough or near enough to the œsophageal varices. Ligation higher and nearer the œsophageal varices will be carried out in a properly selected case. Furthermore, by the use of a minor procedure to thrombose these veins, consideration is being given to the use of small injections of glucose solution into the vein on the exterior surface of the lower end of the œsophagus, with the possibility of thus producing thrombosis of the varices in the intima.

The abnormal position of the liver often will produce a group of symptoms identical with those which have been recognized to be associated with shock, consisting of rapid pulse rate, low blood-pressure, increase in respiratory rate, and anæmic appearance of the skin.[11] Such a depression occurred following the anastomosis between the stump of a hepatic duct and an open-

ing made in the duodenum to relieve a stricture of the common bile-duct. The condition of the patient was so serious seven hours after operation that it was thought best after blood transfusion to open the abdominal incision without moving the patient from her room. This was done without an anæsthetic. The sutures were cut, and a gush of bile occurred to the exterior which appeared to come from the region above the dome of the liver. Almost immediately the patient's condition changed for the better. The pulse rate gradually decreased, and the blood-pressure increased. The following morning, the general condition was satisfactory. Leakage of bile apparently occurred from a small opening in the hepatic duct above the anastomosis inadvertently made during dissection of the stump of the duct from the under surface of the liver. The patient's recovery from then on was without incident and she has been perfectly well since her operation, now more than three and a half years ago. In a study of this problem experimentally in animals, Bollman and I[10] found that the accumulation of bile above the liver depressed and rotated the liver so that the circulation in the inferior vena cava was interfered with, producing experimentally the same symptoms as had occurred in the patient. Likewise with the removal of the displacing medium, immediate rapid recovery took place. I have mentioned this not only to illustrate a rather simple example of the study of a surgical problem and its solution by experimental methods, but from a practical standpoint, to emphasize the value of abdominal exploration if patients are not doing well after an initial surgical procedure. Had the patient's condition been the result of bleeding instead of leakage of bile the bleeding could possibly have been stopped by the introduction of a gauze pack on the surface of which had been placed an astringent styptic powder. In such cases we have found a powder consisting of nine parts boric acid to one part powdered acid acetanilid to be of value.

In conclusion, attention is again directed to the value of the Rowntree-Rosenthal test of hepatic function as the best method now available for determining hepatic function in cases of cirrhosis and metastatic carcinomatosis of the liver. The level of the bile pigment in the blood serum and the constituents and quantity of drainage of bile following operations on the biliary passages not only afford some measure of hepatic function but in certain cases the recognition that too much fluid and sodium chloride are being lost from the body, producing dehydration toxæmia which should be compensated for by replacement of fluid and sodium chloride. Cirrhosis of the liver secondary to disease of the biliary passages has not appreciably increased operative risk in such cases. Finally, certain other problems in cirrhosis of the liver, such as the control of bleeding varices of the œsophagus, afford a broad field for concentrated study.

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TUMORS OF THE EXTRAHEPATIC BILE-DUCTS

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Carcinoma of the extrahepatic bile-ducts, because of its supposed relative infrequency, ordinarily receives but little consideration in the differential diagnosis of lesions in the porta hepatis. Its symptoms are quite variable, and usually even when establishing the diagnosis of malignant obstructive jaundice, are beyond this, noncommittal. None of them is especially characteristic, and very often they are complicated and even overshadowed by symptoms arising from secondary or incidental involvement of neighboring organs. It is no easy matter to establish the correct clinical diagnosis before operation.

According to current conception, these tumors announce their presence so early that when they are found on exploratory laparotomy, they have as yet not metastasized. It is repeatedly contested that the majority of them run their entire clinical course quickly to death in cholæmia long before any metastases occur. It was, therefore, hoped that under early exploration and with improvement of surgical technic, radical resection of these tumors would give good prospect of permanent cure. Yet the number of permanent cures is so far quite small. Numerous cases have been reported with the most extensive metastases. The cases which have undergone successful radical resection have practically all, within two or three years, died of recurrence or metastases. Something must be wrong, therefore, with the original, surgical premise that these tumors do not metastasize.

As a matter of fact, surgical and pathologic study have suffered from lack of material abundant enough to establish any definite conclusions. These, in the light of new experiences, have frequently had to be revised.

In a period of two and a half years at the Cook County Hospital, autopic material was obtained on fifteen cases of tumor of the extrahepatic bile-ducts. Three of these were benign, twelve were carcinomas. As material on the subject goes, this represents a fairly appreciable number, for any one institution can usually muster only a few cases from its own experience. In the course of study of this material, certain clinical associations became prominent by reason of their frequency, and of their previous lack of emphasis. They added in each case, confusing extrabiliary elements to the clinical data. Several pathologic features as they were found in this material were so strikingly at variance with the accepted teachings on the subject as to force their reconsideration. These findings alter the surgical prognosis and may have some bearing in explaining the present ungratifying therapeutic approach.

TABLE

Case I.—Post-mortem No. 15, 1929. Aged sixty-nine years, male, white. Duration—? Time under Medical Care.—Three weeks. Clinical Features in Order of Appearance.—None from tumor; ruptured peptic ulcer. Findings.—Severe anæmia; peritonitis. Clinical Diagnosis.—Ruptured gastric ulcer. Death.—Bronchopneumonia. Location.—Attached to common hepatic duct. Structure.—Gross.—Single, solid. Structure.—Microscopic.—Adenoma. Secondary Effects.—None. Metastases.—None. Incidental findings.—Peptic ulcer.

Case II.—Post-mortem No. 830, 1930. Aged fifty years, female, colored. Duration—? Time under Medical Care.—Two weeks. Clinical features in Order of Appearance.—None from tumor; cardiac decompensation. Findings.—Dependent œdema. Clinical Diagnosis.—Hypertensive heart disease. Death.—Cardiac decompensation. Location.—Between cystic duct and liver. Structure.—Gross.—Single, cystic. Structure.—Microscopic.—Congenital cyst. Secondary Effects.—None. Metastases.—None. Incidental Fndings.—Hypertrophy of heart; subacute glomerulonephritis.

Case III.—Post-mortem No. 811, 1930. Aged fifty-nine years, male, white. Duration.—Fifteen years. Time under Medical Care.—Six days. Clinical Features in Order of Appearance.—None from tumor; cardiac decompensation; gall-stone colic. Findings.—Dependent œdema. Clinical Diagnosis.—Hypertensive heart disease. Death.—Cardiac decompensation. Location.—Stump of cystic duct. Structure.—Gross.—Polypoid. Structure.—Microscopic.—Amputation neuroma. Secondary Effects.—None. Metastases.—None. Incidental Findings.—Hypertrophy of heart; cholelithiasis; chronic cholangitis.

Case IV.—Post-mortem No. 688, 1929. Aged sixty years, male, white. Duration.—Four and one-half months. Time under Medical Care.—Three weeks. Clinical Features in Order of Appearance.—(1) Slight chronic ulcer distress; (2) obstructive jaundice; (3) diarrhœa; (4) cachexia. Findings.—Gall-bladder palpable; liver palpable. Clinical Diagnosis.—Carcinoma of head of pancreas or gall-bladder. Death.—Cholæmia; lobar pneumonia. Location.—Common bile-duct; lower end. Structure.—Gross.—Scirrhus localized. Structure.—Microscopic.—Adeno-carcinoma. Secondary Effects.—Gall-bladder distended; liver enlarged; pancreatic duct obstruction. Metastases.—Peribiliary and peripancreatic lymph-nodes; liver; pancreas infiltrated. Incidental Findings.—Lobar pneumonia; chronic peptic duodenal ulcer.

Case V.—Post-mortem No. 75, 1929. Aged sixty-eight years, male, white. Duration.—Three months. Time under Medical Care.—Three weeks. Clinical Features in Order of Appearance.—(1) Cough; (2) cachexia; (3) rectal obstruction; (4) inguinal lymphadenopathy, biopsy; (5) obstructive jaundice, late. Findings.—Melæna. Clinical Diagnosis.—Carcinoma of rectum. Death.—Cholæmia; bronchopneumonia. Location.—Common bile-duct; lower end extending to junction. Structure.—Gross.—Scirrhus; infiltrating. Structure.—Microscopic.—Scirrhus; goblet cells. Secondary Effects.—Gall-bladder distended; liver normal; ascites. Metastases.—Peribiliary, peripancreatic and periaortic lymph-nodes; mesentery omentum; peritoneum; inguinal lymph-nodes; wall of left ureter; wall of rectum; liver; lungs; pleura; adrenals; pancreas. Incidental Findings.—Bronchopneumonia; left hydronephrosis.

Case VI.—Post-mortem No. 640, 1930. Aged seventy-two years, male, white. Duration—Seven months. Time under Medical Care.—Five weeks. Clinical Features in Order of Appearance.—(1) Diabetes mellitus; (2) vague dyspeptic symptoms; (3) obstructive jaundice; (4) severe abdominal pain; (5) cachexia. Findings.—Glycosuria. Clinical Diagnosis.—Carcinoma of head of pancreas. Death.—Cholæmia. Location.—Common bile-duct; middle extending to junction. Structure.—Gross.—Scirrhus; infiltrating. Structure.—Microscopic.—Adeno-carcinoma; goblet cells; fibrosis. Secondary Effects.—Gall-bladder distended; ascites; liver enlarged; pancreatic duct obstruction. Metastases.—Local metastases to cystic duct; peribiliary lymph-nodes; liver; left adrenal; pancreas infiltrated. Incidental Findings.—Atrophy of pancreas.

Case VII.—Post-mortem No. 759, 1928. Aged seventy-two years, male, white. Duration.—Four and one-half months. Time under Medical Care.—Two weeks. Clinical Features in Order of Appearance.—(1) Severe, acute, atypical ulcer distress; (2) obstructive jaundice; (3) cachexia. Findings.—Gall-bladder palpable; liver palpable. Clinical Diagnosis.—Carcinoma of stomach or head of pancreas. Death.—Cholæmia. Location.—Common bile-duct; middle extending to junction. Structure.—Gross.—Polypoid; infiltrating. Structure.—Microscopic.—Adeno-carcinoma; goblet cells; solid alveoli. Secondary Effects.—Gall-bladder distended; liver normal size; ascites. Metastases.—Peribiliary, peripancreatic and periaortic lymph-nodes with perforation into cisterna chyli; mesenteric lymph-nodes; Virchow gland; liver; right adrenal. Incidental Findings.—Cholecystitic with empyema of gall-bladder; stones in gall-bladder and common duct; duodenitis.

Case VIII.—Post-mortem No. 434, 1928. Aged forty-seven years, female, white. Duration.—Three and one-half months. Time under Medical Care.—Two weeks. Clinical Features in Order of Appearance.—(1) Acute catarrhal jaundice; (2) obstructive jaundice with one early remission; (3) severe secondary anæmia; (4) pseudobiliary colic; (5) cachexia. Findings.—Gall-bladder palpable; liver palpable; melæna severe. Clinical Diagnosis.—Carcinoma of stomach or head of pancreas, or gall-bladder. Death.—Cholæmia; anæmia. Location.—Common bile-duct; lower end. Structure.—Gross.—Scirrhus; localized. Structure.—Microscopic.—Adeno-carcinoma. Secondary Effects.—Gall-bladder distended; liver normal size; pancreatic duct obstruction. Metastases.—Peribiliary lymph-nodes; pancreas infiltrated; duodenum infiltrated. Incidental findings.—Broncho-pneumonia; acute, secondary carcinomatous ulceration of duodenum.

Case IX.—Post-mortem No. 104, 1931. Aged eighty-six years, female, white. Duration.—? Time under Medical Care.—One day. Clinical Features in Order of Appearance.—Admitted moribund; no history; (1) obstructive jaundice; (2) cachexia. Clinical Diagnosis.—Carcinoma of head of pancreas. Death.—Cholæmia. Location.—Common bile-duct; lower end. Structure.—Gross.—Scirrhus localized. Structure.—Microscopic.—Papillary adeno-carcinoma; goblet. Secondary Effects.—Gall-bladder distended; liver normal size. Metastases.—Lung. Incidental Findings.—Chronic peptic duodenal ulcer.

Case X.—Post-mortem No. 685, 1930. Aged fifty-three years, male, colored. Duration.—Two and one-half months. Time under Medical Care.—Two months. Clinical Features in Order of Appearance.—(1) Severe acute ulcer distress; (2) obstructive jaundice; late; (3) severe secondary

anæmia; (4) cachexia. Findings.—Gall-bladder palpable; liver palpable; melenæ severe. Clinical Diagnosis.—Carcinoma of stomach or head of pancreas, or gall-bladder. Death.—Cholæmia; anæmia. Location.—Common bile-duct; middle. Structure.—Gross.—Scirrhus localized. Structure.—Microscopic.—Solid alveolar. Secondary Effects.—Gall-bladder distended; liver enlarged. Metastases.—Peribiliary, peripancreatic and periaortic lymph-nodes. Incidental Findings.—Cholecystitis, but no stones; acute peptic duodenal ulcer.

Case XI.—Post-mortem No. 691, 1930. Aged sixty-eight years, male, white. Duration.—Three months. Time under Medical Care.—Three weeks. Clinical Features in Order of Appearance.—(1) Vague dyspeptic symptoms; (2) obstructive jaundice; (3) pruritis; no cachexia. Findings.—Gall-bladder palpable; melenæ. Clinical Diagnosis.—Carcinoma of head of pancreas. Death.—Cholæmia; bronchopneumonia. Location.—Ampulla of Vater. Structure.—Gross.—Polypoid localized. Structure.—Microscopic.—Adeno-carcinoma. Secondary Effects.—Gall-bladder distended; liver decreased in size; slight pancreatic duct obstruction. Metastases.—No metastases. Incidental Findings.—Bronchopneumonia.

Case XII.—Post-mortem No. 194, 1929. Aged sixty years, male, white. Duration.—? Time under Medical Care.—One day. Clinical Features in Order of Appearance.—(1) Vague dyspeptic symptoms; (2) obstructive jaundice; (3) cachexia. Findings.—Liver palpable; gall-bladder not palpable; melenæ severe. Clinical Diagnosis.—Carcinoma of colon. Death.—Cholæmia; anæmia. Location.—Common hepatic duct; extending to liver. Structure.—Gross.—Scirrhus, infiltrating. Structure.—Microscopic.—Adeno-carcinoma; solid alveoli. Secondary Effects.—Gall-bladder collapsed; liver normal size. Metastases.—Extension to liver. Incidental Findings.—Bronchopneumonia.

Case XIII.—Post-mortem No. 235, 1930. Aged forty-six years, female, white. Duration.—Twelve months. Time under Medical Care.—Two months. Clinical Features in Order of Appearance.—(1) Obstructive jaundice with one early remission; (2) pruritis; (3) gall-bladder distress; (4) cachexia. Findings.—Melenæ; ascites. Clinical Diagnosis.—Carcinoma of head of pancreas. Death.—Cholæmia. Location.—Common hepatic duct extending to junction. Structure.—Gross.—Polypoid infiltrating. Structure.—Microscopic.—Adeno-carcinoma; goblet cells; solid alveoli. Secondary Effects.—Gall-bladder distended; liver enlarged; ascites. Metastases.—Peribiliary and peripancreatic lymph-nodes; liver. Incidental Findings.—Cholecystitis with empyema of gall-bladder; stone at neck of gall-bladder; localized suppurative; pyelophlebitis.

Case XIV.—Post-mortem No. 579, 1929. Aged forty-five years, male, white. Duration.—Ten months. Time under Medical Care.—Three weeks. Clinical Features in Order of Appearance.—(1) Acute catarrhal jaundice; (2) obstructive jaundice; (3) pruritis. Findings.—Gall-bladder palpable; melæna; ascites. Clinical Diagnosis.—Carcinoma of stomach or head of pancreas; or gall-bladder. Death.—Cholæmia; anæmia. Location.—Cystic duct. Structure.—Gross.—Polypoid localized. Structure.—Microscopic.—Carcinoma solidum. Secondary Effects.—Gall-bladder distended; liver decreased in size; ascites. Metastases.—Peribiliary, peripancreatic and periaortic lymph-nodes; liver; wall of rectum and perirectal lymph-nodes; mesenteric, omental, peritoneal and mediastinal lymph-nodes; Virchow gland.

Case XV.—Post-mortem No. 504, 1929. Aged forty years, male, colored. Duration.—Three months. Time under Medical Care.—Two months. Clinical Features in Order of Appearance.—(1) Vague dyspeptic symptoms; (2) ascites; (3) obstructive jaundice; late cachexia. Findings.—Severe ascites. Clinical Diagnosis.—Portal cirrhosis; tuberculous peritonitis. Death.—Cholæmia; bronchopneumonia. Location.—Cystic duct extending to gall-bladder. Structure.—Gross.—Scirrhus infiltrating. Structure.—Microscopic.—Adeno-carcinoma; goblet cells; fibrosis. Secondary Effects.—Gall-bladder distended; liver decreased in size; ascites, massive. Metastases.—Peribiliary, peripancreatic and periaortic lymph-nodes; liver; diaphragm; small intestine; peritoneum, mesentery, Virchow gland.

Benign tumors of the extrahepatic bile-ducts are much less frequent than the malignant ones. In this material, there was one benign tumor to five malignant ones. They are as polymorphic as they are rare. Even the few cases here recorded covered a wide range of form. They included a solid adenoma, a congenital cyst, and an amputation neuroma. None of them affected the biliary outflow. They were all symptomless, autoptic findings without any appreciable clinical or pathologic effect.

The majority of benign tumors are glandular, either papillomas or simple adenomas, single or multiple, cystic or solid. The solid tumors contain a simple, high-columnar, glandular epithelium which may be packed together into solid alveoli. The glandular lining may, however, include a variable number of goblet cells. When these are numerous, mucoid-filled cysts are produced, which may become quite large. Very occasionally, they are associated with stone or other chronic irritation. They are found frequently in animals in association with biliary-tract parasites (Podwyssozki,[1] Hoogland,[2] Larrouse,[3]); in man, rarely.

Grossly, the simple adenoma of Case I resembled an enlarged peribiliary

lymph-node.* There was no stone or other associated irritant. The mass was solid, and was attached to the wall of the common hepatic duct, causing, however, no compression of it. It was composed of almost solid alveoli of regular cells and goblet cells were absent. The patient had died of a perforated gastric ulcer and the node was examined microscopically only because the question was raised of its being a metastasis from a possible malignant transformation of the peptic ulcer. Such malignancy was, however, histologically excluded. (Fig. 1.)

Cysts of the biliary tract are of three main types. They may be saccular dilatations due to some local obstruction at the mouth of a parietal sacculus.

FIG. 1.—Benign adenoma of the common hepatic duct. Composed of solid alveoli of regular cells separated by trabeculæ of fibrous tissue. No goblet cells. Note the two small bile-duct-like structures near the centre. Low power. Magn. 70. Hæmotoxylin and eosin.

Adenomas may become cystic, either by mucoid transformation, or by degenerative changes from circulatory disturbance. Such cystic adenomas are multilocular, and between the loculi, separated muscle fibres of the bile-duct wall are often found (Alexander[4]). Finally, there may be congenital cysts. These are unilocular, and no muscle fibres are ever found in their wall. They represent simple malformations, dilatations of an aberrant bile-ductule isolated without an accompanying acinus of hepatic cells.

* For the material of this case I am indebted to the Department of Pathology of the University of Illinois Research Hospital.

Any of these types of cyst may communicate with the main bile-ducts, or they may not. If they do, they have the same biliary content. If they do not, their content is clear and either watery or inspissated, unless by secondary compression of the main ducts or for some other reason, the patient is jaundiced. Then their content is bile-stained, even though they do not communicate with the ducts (Evans,[5] Grieg[6]).

The congenital cyst in Case II arose from the cystic duct, which rode over it but was not thereby compressed. The gall-bladder was therefore not dilated. The cyst was unilocular and had no muscle fibres in its wall. It did not communicate with the main duct. The patient was not jaundiced. The

FIG. 2.—Low-power view of amputation neuroma hanging into the dilated cavity of the stump of the cystic duct. Leitz apochromat 35 periplanar 6. Mallory phosphotungstic acid hæmotoxylin.

cyst content was therefore unstained. The cyst was an incidental finding, and the patient died of a hypertensive heart disease with cardiac decompensation.

Other benign tumors which have been recorded in the extra-hepatic bile ducts include submucous lipomas, fibromas, adenomyofibromas, hydatid cysts, xanthomas, and one melanoma (Duval[7]). Lympho-granulomatous tumor masses in Hodgkin's disease involving the bile-ducts have been described (Stahr[8]). Hammesfahr[9] reported a foreign body granuloma developing around a non-absorbable catgut ligature used after cholecystectomy, and causing a stricture of the common duct.

In Case III (see Table), a cholecystectomy had been done fifteen years before. At autopsy, the stump of the cystic duct was found dilated, and an irregular stone had formed within it. Faceted stones were also present in the ampulla of Vater. They occluded it, and led to a chronic intra- and extra-

hepatic cholangitis. Hanging like a polyp into the dilated stump of the cystic duct, there was a caterpillar-shaped histologically typical amputation neuroma. (Figs. 2 and 3.)

It was 15 millimetres long and 5 millimetres in transverse diameter, quite firm, and covered by a light yellow, smooth membrane of mucosa. The bulk of the polyp was composed of two structures which interlaced with each other in various directions. There were bundles of fibres to which were attached long, band-shaped, finely granular nuclei. These fibres showed little affinity to the hæmotoxylin-eosin, Van Gieson or Mallory phosphotungstic acid stain. With the latter stain they appeared very light purple. Between these fibres there was a moderate number of small blood-vessels.

FIG. 3.—High-power view of amputation neuroma. Mallory phosphotungstic acid hæmotoxylin stain. Bundles of nerve fibrils (more lightly stained) separated by strands of darkly stained fibrous tissue. Leitz apochromat 16 periplanar 6.

The second type of structure was formed by bundles of connective tissue stained reddish-brown after Van Gieson and bright purple after Mallory stain. Nerve bundles in the wall of the cystic duct were found extending into the polyp where they fused with the bundles of light-stained fibrils. (Dr. R. H. Jaffe.)

The cystic-duct stone and the infection may have been factors favoring the formation of the neuroma, but it, itself, had caused no obstruction or any other symptoms. The patient did complain of recent biliary colics but these could be accounted for by the stones. He died under the clinical picture of cardiac decompensation. Husseinoff[10] reports the only other case which I could find in the literature, of amputation neuroma of the cystic duct. They are much less infrequent in the appendix.

All benign tumors of the extrahepatic bile-ducts, by reason of their location, have the same mechanical effects as do malignant ones, except that they may long remain extrinsic and inert. Once they involve the biliary outflow their immediate effects are just as alarming. Therapeutic interference follows the same principles as with malignant tumors. The prognosis is, of course, much better. A resection once effected establishes permanent cure (Giezendanner,[11] Diaz[12]).

Carcinoma of the extrahepatic bile-ducts is usually considered to be relatively infrequent as compared with carcinomas of other organs in the region of the porta hepatis. Gall-bladder carcinomas are held to be five times as frequent as bile-duct carcinomas. Carcinoma of the head of the pancreas is usually the first clinical thought in cases of chronic, painless, progressive jaundice.

In 2500 autopsies at the Cook County Hospital, performed in a little over two and one-half years, there were, however, only six cases of carcinoma of the gall-bladder, and only four cases of carcinoma of the head of the pancreas, as compared with twelve cases of carcinoma of the extrahepatic bile-ducts. There were at the same time eleven cases of primary carcinoma of the liver (both cholangio- and hepato-cellular). There were, altogether, about 325 cases (13 per cent.) of carcinoma of all kinds.

According to this material, carcinoma of the extrahepatic bile-ducts comprises 3.7 per cent. of all carcinomas. It is about as frequent as primary carcinoma of the liver. It is twice as common as carcinoma of the gall-bladder, and three times as common as that of the head of the pancreas. If only from the standpoint of relative frequency, it requires, therefore, greater consideration in the differential diagnosis of primary tumors of the porta hepatis than is usually given it.

It occurs most commonly in men, in contrast with carcinoma of the gall-bladder, 80 per cent. of which occurs in women (Ewing[13]). In our twelve cases, there were nine men and three women. Ten of the patients were white, two were colored. In this hospital twice as many autopsies are held on men as on women, and twice as many on white patients as on colored. Correcting for this factor, we have left an absolute proportion of nine men to six women, and ten white patients to four colored. According to our material, therefore, 60 per cent. of carcinoma of the extrahepatic bile-ducts occurs in men, and only 40 per cent. in women; 71 per cent. occurs in white patients, 29 per cent. in colored.

The patients were usually well advanced in years. Their ages varied from 40 to 86 with an average of 59.7 years. Rolleston[14] gives an average of 55.5 years. Most of the cases were between 50 and 70.

The clinical course was comparatively rapid. The total duration of biliary or associated major symptoms varied from two and one-half months to one year, with an average of 5.3 months. Rolleston, too, gives an average duration of five to six months.

It is repeatedly emphasized that because of their strategic location, these tumors declare themselves rather promptly. But their declaration is so

variable and often so noncommittal that an early diagnosis is extremely difficult. For some time, also, the symptoms are fairly mild, so that patients do not even seek medical attention. The cases here recorded were under known medical supervision for only two weeks to two months before death, with an average duration of alarming symptoms of only one month. Thus, though these tumors announce their presence promptly enough, they are actually available for therapeutic approach for only a very short period of time.

Even in this short period of time, the clinical picture is rarely simple and characteristic. The clinical syndrome usually described is composed of an insidious onset with the first symptom a painless, steadily, relentlessly progressive obstructive jaundice, with rapid loss of weight and strength until death occurs in simple asthenic cholæmia. Such a picture is, in fact, rare. Much more often there are variations and complications which long hamper the correct diagnosis.

Jaundice is held to be usually the first and the most reliable symptom (see Musser[15] and Renshaw[16]). In this material, however, jaundice was not the first symptom. Case VI was admitted as a simple, mild, senile, arteriosclerotic diabetes mellitus. While in the hospital, under fairly well maintained diabetic control, he incidentally developed a rapidly and steadily progressive obstructive jaundice which in one month led to death. Case XV began with an ascites which so dominated the clinical picture as to suggest a preliminary diagnosis of portal cirrhosis or tuberculous peritonitis. Jaundice first appeared only three weeks after the onset.

Case V entered with the complaints of pain in the back, cough, weakness and loss of weight. Rectal examination revealed a firm mass bulging into the rectal lumen. The right inguinal lymph-nodes became enlarged, and biopsy of one of them revealed a metastatic colloid carcinoma. Only nine days before death from a bronchopneumonia, a slight icterus appeared. The clinical diagnosis was carcinoma of the rectum with metastases to the liver. At autopsy, a carcinoma of the common bile-duct was found, which had announced itself by rectal, inguinal and lung metastases long before it had produced jaundice. Cases VIII and XIV presented an acute onset of gastrointestinal and slight febrile symptoms, followed shortly by the onset of jaundice. They simulated at first the so-called "acute catarrhal jaundice." Only the persistence and progress of the jaundice finally established the correct diagnosis.

Several cases gave a history of chronic dyspeptic symptoms preceding the onset of the obstructive jaundice for a long time. In four (Cases VI, XI, XII and XV), these were mild and rather vague, characteristic of neither ulcer nor gall-bladder pathology. In others, however, they were definitely referable to an associated peptic ulcer. Case IV had complained of mild post-prandial pain in the left upper quadrant for years. It was readily relieved by food or soda. In Case X, ulcer symptoms dominated the clinical picture. It began with a vague ulcer distress which soon grew worse, ceased to yield to soda or diet, and finally drove the patient to seek medical aid.

Only when he came into the hospital was it noticed that a jaundice had begun. Case VII began with a dull aching epigastric pain which followed a duodenal ulcer rhythm, but was not quite typical. It was not relieved by soda, nor aggravated by fats. At autopsy, a severe duodenitis was found to be the basis for this distress. Case IX too had a chronic duodenal ulcer, but she was admitted in moribund condition and no history was obtainable. Altogether, in ten out of eleven cases, jaundice was not the first symptom.

The jaundice was not usually painless. Distress of one type or another was present in ten out of the eleven cases in which a history was obtained. This was dyspeptic in four cases, of ulcer type in three. In Case XIV, typical severe ulcer symptoms began after the onset of jaundice. Gall-bladder symptoms were interjected in two more cases. Case XIII, with the longest duration of symptoms, began to suffer eight months after the onset of jaundice from typical immediate post-prandial distress with bloating, belching and fat intolerance. Case VIII had no stones nor cholecystitis, but five weeks before her death there developed sudden, violent, biliary colics which required morphine for relief. These stoneless, or "pseudo-stone," colics are usually attributed to spasmodic contraction of the tense gall-bladder, or to irritative spasm of the duct. Case VI, in addition, suffered terminally from a steady upper abdominal pain which became severe enough to require morphine. There were no characteristic lesions to account for it. Involvement of the cœliac plexus by tumor infiltration may, however, be suggested.

Jaundice was not always the most prominent symptom. It eventually dominated the clinical picture in seven cases. In three cases (VII, X and XIV), however, severe ulcer symptoms were always predominant; in Case XV the ascites, in Case V the metastases were most prominent.

The jaundice was not always steadily, relentlessly progressive. In several cases, there were intermissions in the jaundice which would have favored rather a diagnosis of stone. Early variations in the jaundice were seen in Cases VIII and XIII. This is ascribed to transient local inflammation or œdematous swelling, or prolonged spastic contraction of the duct (Brulé[17]). Later intermissions in the jaundice may occur from necrosis of the tumor with temporary resumption of bile flow. This is especially common in tumors of the ampulla or lower end of the common bile-duct. It is an important diagnostic aid when it occurs, since it differentiates these tumors from carcinoma of the head of the pancreas (Elkin,[18] Aynaud,[19] Devic et Gallavardin[20]).

The jaundice appeared quite late in only three cases of carcinoma of the common duct (Cases V, VII and X). In one case, also, of carcinoma of the cystic duct, it appeared quite late. In the latter location, only when the tumor or its metastases reach the hepatic or common bile-ducts or liver, can jaundice appear. Poynton[21] recorded one case of carcinoma of the common bile-duct which ran a rapid clinical course to death with widespread metastases, without any jaundice at all. Moll[22] described a sarcoma of the ampulla of Vater without jaundice.

Pruritus accompanied the jaundice in two cases (XIII and XIV), and followed its onset in a third (XI). Bilirubinæmia, bilirubinuria and acholic stools were constant accompaniments. Diarrhœa was marked in only one case (IV). Melæna appeared in seven cases, and in each was a confusing finding. In three it was due to massive bleeding from duodenal ulceration, in Case X an incidental peptic ulcer, in Case VIII a secondary carcinomatous ulceration, in Case XIV a decubitus ulcer overlying metastatic lymph-nodes. In Case XII massive gastro-intestinal bleeding without any definite lesion occurred as part of the hæmorrhagic diathesis of jaundice. In these four, blood appeared in the stools in large quantities, and severe secondary anæmia outraced the cholæmia in causing death. Hæmorrhagic diathesis led to slight or moderate melenæ in Cases V, XI and XIII and in each aroused the suspicion of carcinoma of the stomach or large bowel.

Severe cachexia was prominent in all cases except XI. The gall-bladder was palpable clinically in only six of the twelve cases. Courvoisier's law thus held in only 50 per cent. (Vincent[23]). The liver was palpably enlarged in four of these six cases. It was palpable also in Case XII. Here a carcinoma of the common hepatic duct had caused hepatic enlargement without giving gall-bladder enlargement. Ascites was found in three cases. The spleen was never palpable.

The case of carcinoma of the ampulla of Vater (XI), followed much the same clinical course as the others. The accepted differential features, such as the greater tendency to suppurative cholangeitis, to necrosis of the tumor with melæna and intermission of jaundice, to more marked diarrhœa and to more marked pancreatic-duct obstruction, were not present in this case. There was no steatorrhœa or azotorrhœa, or glycosuria. The pancreas and its duct were only slightly involved. Chiray[24] and Carnot[25] have done considerable work with duodenal aspiration in an effort to distinguish biliary from pancreatic carcinomas. The method readily distinguishes biliary or pancreatic or common obstruction, but the results are ambiguous. For carcinoma of the common bile-duct may infiltrate the head of the pancreas and occlude the latter's duct even before jaundice occurs. Carcinoma of the head of the pancreas may, on the other hand (as it did in a recent case in our laboratory, Post-Mortem No. 64, 1931) compress the bile-ducts to produce jaundice, while leaving the pancreatic duct still free. Stone may similarly occlude the pancreatic or biliary duct or both, and give almost the same "tubage" findings as carcinoma.

The early diagnosis of carcinoma of the extrahepatic bile-ducts, even an early diagnosis, in these cases, of malignant obstructive jaundice, is no easy task. The jaundice is often only a clinical afterthought. Even when it does appear, the symptomatology is so variable, so non-committal, and so often burdened with incidental complications, that only a vague tentative diagnosis can be made. The most that can be expected in these cases is a diagnosis sufficiently definite to warrant early exploratory laparotomy. Even this is not always possible.

The clinical diagnosis usually made when malignant obstructive jaundice was finally established was carcinoma of the head of the pancreas. The findings are practically the same, but from the standpoint of relative frequency, as shown at least in our material, it would have been three times more often correct to have diagnosed carcinoma of the bile-ducts. Carcinoma of the gall-bladder was more readily differentiated by its preponderance in women and frequent association with stone. Stone often had to be considered because of the cases with pain, or with jaundice intermissions, or with non-palpable gall-bladder. Carcinoma of the liver, of the stomach or colon, catarrhal jaundice, portal cirrhosis and tuberculous peritonitis were all at some time considered, so polymorphic and indefinite were the clinical pictures presented.

Death occurred characteristically in four cases in cholæmia, from the flooding of the blood by toxins normally destroyed in the liver or excreted through the bile. But there were many variations, for jaundice carried with it the implication of susceptibility to infection and hæmorrhage. In three cases, bronchopneumonia hastened the fatal issue, in a fourth case lobar pneumonia. In four cases, massive gastro-intestinal bleeding with severe secondary anæmia was the essential lethal factor.

At autopsy, the most frequent location of the tumor was found to be the common bile-duct. There were four in its lower end, and three in its midportion. Two were in the common hepatic duct, two in the cystic duct and one in the ampulla of Vater. This conforms in general to most of the statistics on the subject except that these usually include a large proportion of tumors at the junction of common, cystic and hepatic ducts. Rolleston[14] lists thirty-four in the common bile-duct, twenty-eight in the junction, nineteen in the common hepatic duct, six in the cystic duct, and four in the right or left hepatic duct. The rarest location is the left hepatic duct (Wylegschanin[26]).

The primary tumor was nearly always quite small. Grossly they were either scirrhus, flat, annularly infiltrating (eight cases), or polypoid friable masses (four cases). Wherever they start, these tumors tend to spread along the duct walls. The scirrhus tumors circle the duct to form stenosing rings, and then spread up or down to form rigid carcinomatous tubes. The polypoid tumors first fill up the lumen, and then spread along the walls. The intramural spread was limited in four of the scirrhus and two of the polypoid tumors, and was extensive in four of the scirrhus and two of the polypoid. There was therefore no difference between the scirrhus and polypoid tumors in their tendency to intramural spread.

One of the common hepatic-duct tumors and three of the common bile-duct tumors had spread until they reached the junction. In no case was the bulk of the tumor just at the junction, and usually it was fairly apparent that it had reached that point by mucosal spread. The junction of the cystic, hepatic and common bile-ducts stands in a centrally located position to meet the tumors growing towards it from any of the main ducts. It is not sur-

prising, therefore, that it is often involved, but this involvement is secondary. More accurate anatomic localization of the tumors will reduce the number listed as junctional, or "confluence," or "carrefour" tumors (Brocq[27] and Pliveric[28]).

Tumors in the region of the papilla of Vater may arise from the bile-duct, from the pancreatic duct, from the mucosa of the ampulla proper (the biliary-pancreatic pylorus of Hanot[29]), from the head of the pancreas, or from the duodenal mucosa or Brunner's glands. The parts are so small that it is often impossible to distinguish the exact site of origin, and the tumors are classified simply as carcinomas of the papilla of Vater. Ampulla carcinomas are usually cylindrical-celled adeno-carcinomas; the pancreatic ones are usually small, round-celled carcinomas. The adeno-carcinoma in Case XI was small enough to permit accurate localization from the ampulla with slight extension into the lower end of the common bile-duct.

There was no striking difference between the scirrhus and polypoid tumors in their microscopic structure. Most of the tumors were composed of irregular glands lined by columnar epithelium with cuboidal to cylindrical cells, and anaplastic nuclei (eight cases). The glands were separated by a small to moderate amount of fibrous tissue. The lining cells were sometimes piled up into several layers. This tendency to form solid alveoli was slightly more marked in the polypoid forms; the tendency to fibrosis was slightly more marked in the scirrhus. There was, in addition, one almost solid alveolar carcinoma which was grossly scirrhus, and one pure carcinoma solidum which was grossly polypoid. There was one microscopically scirrhus carcinoma with a large amount of fibrous tissue between the single cancer cells of the primary tumors. In the metastases, however, there was much less fibrosis and more anaplasia. There was finally one case of papillary adenocarcinoma. Squamous-cell carcinomas of the extrahepatic bile-ducts have also been reported (Fehr[30] and Cabot[31] but none were found here.

A striking feature of the microscopic sections, in both the scirrhus and polypoid forms, was the tendency to colloid degeneration (six cases). The tumors resembled those of intestinal epithelium with numerous goblet cells and the production of much mucoid material. (Fig. 4.) This was even more marked in the metastases than in the primary tumors. Pseudomyxoma peritonei is well known to originate from bile-duct carcinomas.

Normally, there are no goblet cells in the lining epithelium of the bile-ducts. It was therefore suggested that the simple adeno-carcinomas arose from the surface epithelium or from the parietal sacculi, while the colloid carcinomas arose from the mucous glands which open into the sacculi. There is no definite proof for this except the vague resemblance between goblet cells of mucous glands and vacuolated carcinoma cells. Under any chronic irritation, goblet cells appear in the bile-duct lining. The bile-ducts are intestinal evaginations. The parietal sacculi and associated glands represent only branched diverticula of the original intestinal outpouching (see Keibel and Mall[32]). The origination under irritation of colloid carcinomas is a

common faculty of any part of the bile-duct epithelium, an expression only of its original intestinal character.

Whatever its location or character, the crucial result of these tumors is obstruction to bile flow. This is accomplished by annular scirrhus stricture, by occlusion by polypoid masses, or by compression by peribiliary lymph-node metastases. It is favored by the low secretory pressure of bile, and by muscular spasm of the ducts (see Vander Veer[33] and Wahl[34]).

The first consequence of biliary obstruction is dilatation of the proximal portion of the biliary system. In all common bile-duct tumors the gall-bladder is distended by biliary retention unless some previous cholecystitis has rendered its dilatation impossible. In cystic-duct tumors it is distended

FIG. 4.—Papillary adeno-carcinoma of the common bile-duct. Note the goblet-cell lining and extensive pseudo-mucin production. Leitz apochromat 8 mm. periplanar 6. Hæmotoxylin and eosin.

by transudation of serum (Hellner[35]). Extension of a ductus choledochus tumor to the "carrefour" shuts off communication between cystic and hepatic duct, changing the character of fluid in the gall-bladder, but not reducing its distention. In hepatic-duct tumors, the gall-bladder is collapsed (Case XII), unless extension to the junction or an incidental stone (as in Case XIII) has blocked the cystic duct (Gebele[36]). Altogether, in 80 to 90 per cent. of carcinomas of the bile-ducts, the gall-bladder is distended, even though it is palpable clinically in only about 50 per cent.

The intrahepatic bile-ducts are similarly dilated in all common bile- or hepatic-duct tumors, and in cystic-duct tumors if the latter or their peribiliary lymph-node or hepatic metastases (as in Case XIV) compress the direct biliary channels. There is a deep icteric pigmentation of the liver, and, in

severe cases, a centro-acinar icteric necrosis (see Fueterrer[37]). The liver is enlarged by distention or metastases unless a cirrhotic or atrophic degeneration has reduced it. It was found definitely enlarged in four cases, of about normal size in five cases and decreased in size in three cases. Three times it was palpable clinically, yet normal in size; twice it was enlarged, but not palpable.

The pancreas was rarely much disturbed. The pancreatic duct may be directly occluded at its orifice, or be constricted by diffuse carcinomatous infiltration of the head of the pancreas. One-third of the bile-duct carcinomas arise in the lower part of the ductus choledochus close to the ampulla. But pancreatic-duct occlusion is not usual, for the duct does not always enter the duodenum in common with the ductus choledochus (Springer[38]). It may enter at quite some distance from it (as it did in Case IX), with or without a papilla of its own. Even if the Wirsungian duct is occluded, the accessory duct of Santorini is actually the main duct in 12 per cent. of cases and can substitute adequately for the main duct in draining the pancreatic external secretion, in another 54 per cent. (Keen[39]). The pancreatic duct was partly obstructed in four cases but no marked deficiency in pancreatic external secretion followed.

Nor did it in any case seriously disturb the pancreatic internal secretion. Indeed, duct obstruction leads to island regeneration (Opie[40]) unless this is prevented, as it was in Case VI, by a preceding arteriosclerosis (Dr. R. H. Jaffe). There was a chronic interstitial pancreatitis in Case VIII; in Case IV the pancreas was reduced to a fibrotic shell, but glycosuria did not follow.

Ascites was present in six cases; from carcinomatosis of the peritoneum in Cases V and XV, from compression of the portal vein by enlarged peribiliary lymph-nodes in Cases VII and XIV, from hepatic metastases alone in Case VI, from suppurative pyelophlebitis adjacent to hepatic metastases in Case XIII. The ascites was massive only in Case XV.

In Cases VII and XIII a cholecystitis was present, with a stone at the neck of the gall-bladder and a chronic empyema. In Case VII the cholecystitis was perfectly symptomless. Here there were stones also in the ductus choledochus distal to the tumor. In Case X there was a chronic ulcerative cholecystitis, but no stones. In our material, stone was associated with carcinoma of the bile-ducts in only 16 per cent. This is usually given as 30 per cent., in striking contrast with carcinoma of the gall-bladder, in which stone is present in fully 80 per cent. (Miller[41]).

The frequent association of stones with primary carcinomas of the gall-bladder and their absence in secondary carcinomas led to the assumption that they were very important in the etiology of carcinoma of the gall-bladder. This was used as an argument in favor of cholecystectomy for stone, rather than cholecystotomy. White[42] declared that 20 per cent. of all persons with gall-stones ultimately developed biliary-tract carcinomas. Lotzin,[43] however, emphasized that this was exaggerated, and, further, that it was not the stone

itself which led to the carcinoma. Both were the result of mucosal irritation induced by the same toxic-infectious-metabolic factors.

A similar importance was ascribed to stone in carcinoma of the bile-ducts (Coffey[44]). Rarely is a history of stone obtained, but this is attributed to the symptomless character of 75 per cent. of stones. Rarely is stone found at all, and when it is found, it is usually in the gall-bladder and not at the site of the tumor. This is explained as due to extrusion of the stone, which, in its passage, irritated the bile-duct mucosa sufficiently to set up a carcinoma. Better evidence than this must be offered before stone can be accepted as having any significance in the etiology of bile-duct carcinoma.

The most striking association of all was that of duodenal ulcer. There were two cases of old, chronic, peptic duodenal ulcers. There was one severe subacute duodenitis which had preceded the jaundice. There was one case of acute peptic ulcer of the duodenum primary to and with no direct relation to the tumor. There was one secondary carcinomatous invasion of the duodenum with ulceration of the mucosa. There was one decubitus ulceration of the duodenal mucosa overlying enlarged, metastatic, peripancreatic lymph-nodes. In these last three, there followed severe gastro-intestinal bleeding and high-grade secondary anæmia.

Only two cases were subjected to operation. In Case XI, exploratory laparotomy was done three weeks after the gradual onset of jaundice. A cholecystotomy was performed. There was profuse drainage of bile. The jaundice subsided, but the post-operative reaction was poor. The patient vomited persistently. He died twenty days later of a bronchopneumonia. In Case X, exploratory laparotomy was done to establish diagnosis, for symptoms were mostly referable to the acute peptic ulcer. Cholecystotomy was done, six weeks after the onset of symptoms. Extensive lymphatic metastases were already present. Death occurred one week later from progressive anæmia from the bleeding duodenal ulcer.

The futility of operative interference was emphasized in these cases not so much by their diagnostic difficulties, not so much by these unexpected and unavoidable complications, as by the presence of widespread metastases.

In some cases, at least, a tentative diagnosis of obstructive jaundice can be made. The proper procedure in a patient of middle age who became deeply jaundiced, with or without pain, whose jaundice persisted for fourteen days, and whose temperature remained or returned to normal, would be exploratory laparotomy (Pliveric[28] and Bruett[45]). If stone or cholecystitis were found they could be properly dealt with, before more liver damage took place. If malignancy were found, there would be an earlier chance for surgical attack.

The technical difficulties of operating on the delicate structures of the biliary tract were a challenge to surgical skill and ingenuity which has been successfully met. Radical resections with reconstruction of the biliary tract are now being performed with an immediate operative mortality of about 45 per cent. (Kausch,[46] Gibbons[47] and Fulde[48]). The greatest element caus-

ing failure in these cases now is not the operative maneuver but the hæmorrhage, shock and infection to which the jaundiced patient is so markedly susceptible, and to accidental complications such as those described in our cases (see Stanton[49]).

The supposition that these tumors announced their presence by striking and characteristic symptoms long before they metastasized, and could therefore be approached with good prospects of permanent cure, had markedly stimulated the perfection of technic and of pre- and post-operative manage-

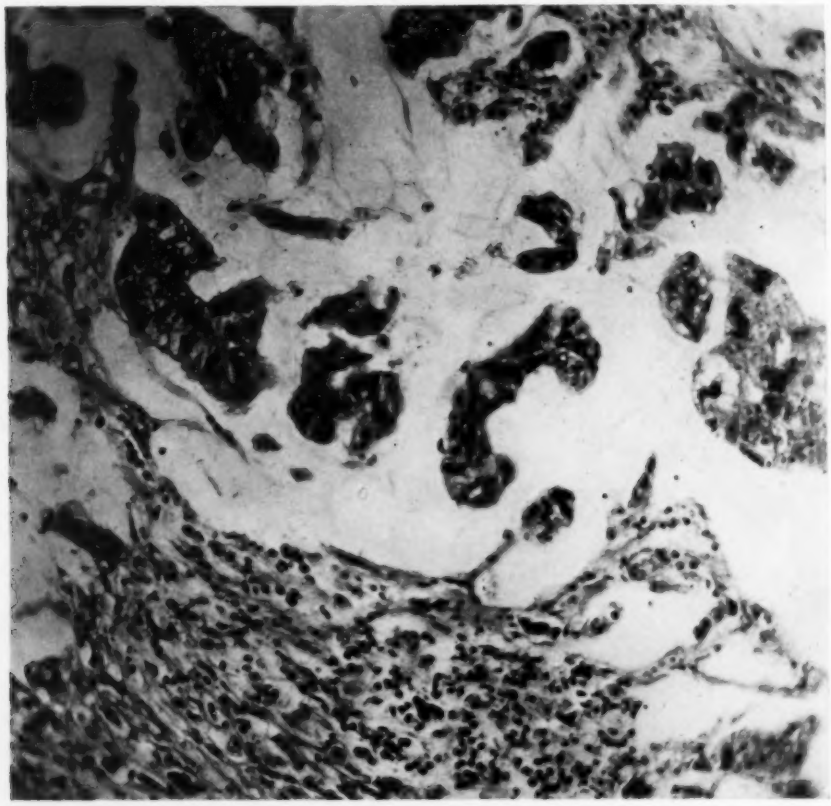

FIG. 5.—Colloid carcinoma metastasis in marginal sinus of inguinal lymph-node. Note papillary infolding. Primary tumor in common bile-duct. Leitz apochromat 8 mm. periplanar 6. Hæmotoxylin and eosin.

ment. It was usually considered that metastases occur in only 20 per cent. of bile-duct carcinoma. But even with successfully effected radical resections, permanent cures have been very few. The hopefulness of radical resection was a surgical mirage (Thévenod[50]).

These tumors, according to our material, are not less prone than others to metastasize. They do not declare themselves forcibly and unequivocally long before they metastasize. The clinical course, especially that part of it which is severe enough to demand medical attention, is brief. In this short time, metastases are already widespread. Metastases were present in all our twelve cases except one.

There was no difference between the scirrhus and polypoid types in their tendency to metastasize. Both issued extensive and widespread metastases while they were yet quite small. The adjacent peribiliary, peripancreatic, and periaortic lymph-nodes were most frequently involved. The liver came next in frequency. The pancreas was often infiltrated; adrenals, lungs, pleura, rectum, ureter, ileum, peritoneum, mesentery, and omentum were all involved. A Virchow gland was palpable in three cases. Extensive lymphatic spread was common. The metastases or their immediate effects appeared in two cases even long before the miniature primary tumor made itself at all known. (Fig. 5.) In view of these facts, not much can be expected from radical resection until the presence of these tumors can be ascertained long before they are now recognized.

CONCLUSIONS

A clinical and pathologic study is presented of fifteen cases of tumor of the extrahepatic bile-ducts. These included one amputation neuroma of the cystic duct, one solid adenoma, one congenital cyst and twelve carcinomas. According to this material, carcinoma of the extrahepatic bile-ducts was twice as common as carcinoma of the gall-bladder and three times as frequent as carcinoma of the head of the pancreas. It should be given, therefore, greater consideration in the differential diagnosis of lesions of the porta hepatis.

The clinical course, especially that part of it which was severe enough to demand medical attention, was brief. The clinical syndrome was usually atypical. Jaundice was usually not the first symptom, it was usually not painless, it was not always steadily progressive. It was not always the most prominent symptom and often appeared quite late. The clinical picture was often masked by symptoms arising from accidental complications, particularly duodenal ulcerations, or from the metastases.

There was no difference between the scirrhus and polypoid tumors in their tendency to intramural spread, in their histologic structure, or in their tendency to metastasize. The tendency of these tumors to colloid degeneration with numerous goblet cells is an expression of the original intestinal character of the bile-duct epithelium. The frequency of duodenal complications is noteworthy.

The premise that these tumors announce their presence and even kill before they metastasize is not supported by this material. Metastases were common, extensive and widespread, and in some cases dominated the clinical and pathologic picture. Small as they are, contrary to current conception, these tumors send out metastases long before they announce their own presence. This may account for the present, ungratifying permanent results of radical resection.

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HÆMATOLOGIC STUDIES AS A BASIS FOR DETERMINING THE RISK OF POST-OPERATIVE HÆMORRHAGE IN JAUNDICE PATIENTS*

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One of the most serious problems in operative surgery is the deeply jaundiced patient. It is generally agreed that these patients are very poor operative risks. In many instances death is caused by pneumonia or post-operative infection, due to poor resistance.

However, hæmorrhage is the most frequent complication and at the same time the most important factor in post-operative mortality. Broadly speaking, the risks of a post-operative hæmorrhage depend on two factors: (1) the degree, and (2) the duration of the jaundice. Each one of these two factors may cause post-operative hæmorrhage. For instance, a moderate jaundice of long duration or a very deep jaundice of short duration may be equally potent. When both factors are combined, any operative interference presents a most serious problem for the surgeon.

Furthermore, we cannot, before the operation, definitely predict whether a jaundiced patient will bleed. It is a well-known fact that a patient with deep jaundice of long duration may not bleed after the operation, whereas another patient suffering from a moderate jaundice of short duration may succumb to post-operative hæmorrhage.

It would be of the utmost importance if our laboratory investigation would enable us to segregate the bad risks from those who are apt to make an uninterrupted post-operative recovery. It is generally conceded that the pre-operative determination of the clotting time is without any practical value. Normal clotting time is no safeguard against post-operative bleeding. Even after the hæmorrhage has started, the clotting time may still be normal. In other cases, the clotting time may be lengthened considerably, yet the patient with a deep jaundice of many months' duration may make a smooth post-operative recovery.

Another test, namely, the icteric index, is of no practical value in the subject under discussion. As stated above, patients suffering from deep jaundice of long duration may make a smooth recovery, even after major operations. The icteric index is simply a numerical indicator of the degree of jaundice. It has been known for many years that large amounts of bile acids can be present in the blood for months, and even years, without causing any symptoms of toxicity or blood dyscrasia. As Wangensteen has stated:

*Read before the Joint Meeting of the New York Surgical Society and the Philadelphia Academy of Surgery, February 11, 1931.

"Bile-acid intoxication is not the explanation for bleeding in obstructive jaundice."

So much for the negative side of the value of hæmatologic studies in jaundiced patients. Are there any other methods of blood investigation available which may be of importance in evaluating the risk of hæmorrhage in the jaundiced patient? Bancroft, Kugelmass and Stanley-Brown have recently investigated in a large number of cases the prothrombin, the antithrombin and the fibrinogen contents of the blood. The main object of their investigations was to identify those patients who, in their post-operative course, might be subject to thrombosis and embolism, and to attempt to change this tendency by dietary measures.

We are not concerned here with their very interesting researches along these lines. However, it seemed to me that similar blood studies might be of value in an attempt to determine before the operation the surgical risk in the jaundiced patient.

The tests are performed at the Fifth Avenue Hospital in the following manner:

(1) Nine cubic centimetres of blood are taken from the vein and put into 1 cubic centimetre of 1 per cent. sodium oxalate. Blood is centrifuged and the plasma is removed.

(2) *Prothrombin test.*—One-tenth cubic centimetre of the plasma is placed in three tubes in a water bath 38° C. and to these are added in series 0.1, 0.2, 0.3 cubic centimetres of 0.5 per cent. $CaCl_2$ x 6 H_2O. The shortest clotting time in the series is the prothrombin time. The prothrombin index is the ratio of the clotting of the control to that of the patient's blood.

(3) *Fibrinogen test.*—To 1 cubic centimetre of plasma add 28 cubic centimetres of 0.8 per cent. NaCl and 1 cubic centimetre of 2.5 per cent. $CaCl_2$. Mix and allow to stand twenty minutes. Break up the jelly by shaking slightly and transfer to a dry filter. While filtering, insert into jelly a slender glass rod with a pointed end and whirl gently. All the fibrin will stick to the rod. Slip the fibrin off the rod and press it between dry filter paper to remove as completely as possible the adhering liquid. Transfer it to a 15-cubic-centimetre centrifuge tube, add 4 cubic centimetres of 1 per cent. NaOH. Place the tubes in a boiling-water bath and stir with a slender glass rod until the fibrin lump has completely disintegrated. The fibrin has now dissolved, leaving the CaC_2O_4 in suspension. Add 10 cubic centimetres of H_2O and transfer the supernatant liquid to a 25-cubic centimetre volumetric flask. Add 1 cubic centimetre of 5 per cent. H_2SO_4 and 0.5 cubic centimetre phenol reagent and dilute to about 20 cubic centimetres. Add 4 cubic centimetres of 20 per cent. Na_2CO_3 solution. Shake, make up to 25 cubic centimetres. The standard is prepared as follows:

Measure 1 cubic centimetre of standard tyrosine solution into 25-cubic centimetre volumetric flask. Add 0.5 cubic centimetre of phenol reagent diluted to about 20 cubic centimetres and add 4 cubic centimetres of 20 per cent. Na_2Co_3. Make up to volumetric. The standard should be prepared at the same time as the unknown. Let stand for fifteen minutes before making the color comparison.

(4) *Antithrombin test.*—Some of this plasma is recalcified by adding 2, 3, 4, 5 drops of a 0.5 per cent. $CaCo_3$ x 6 H_2O solution to ascertain general coagulability of plasma. Heat 2 cubic centimetres of plasma to 60° C. Prothrombin is destroyed and fibrin coagulated. Filter off coagulum. Plasma contains antithrombin and no prothrombin. Prepare human plasma from normal case the same as oxalated plasma to be tested.

Five cubic centimetres of this plasma are put into the tubes.
To first tube, add 3 cubic centimetres normal filtered plasma.
To second tube, add 2 cubic centimetres normal filtered plasma.
To third tube, add 3 cubic centimetres of filtered plasma to be tested.
To fourth tube, add 2 cubic centimetres of filtered plasma to be tested.
All tubes are equalized in amount by addition of 0.9 per cent. NaCl. Mixtures are allowed to remain in contact fifteen minutes at 37.5° C. Plasma is recalcified by addition of 0.5 per cent. $CaCl_2$ x 6 H_2O, the number of drops which are added having been determined by the general coagulability test. The clotting time is observed at 37.5°C.

Determinations of clotting factors were performed in sixteen cases of jaundice. Some cases were nonsurgical, a few patients refused operation and others were cases of light jaundice with normal figure. They do not belong to the group under discussion.

I wish to report here very briefly results of these studies in seven cases. All these patients suffered from deep jaundice of long standing. Their scleræ were deeply yellow, assuming in some instances a greenish tinge. Stools were completely acholic. The urine was dark brown and full of bile. In other words, they presented intense jaundice and represented the worst forms of operative risk.

Case I. No. 320186.—M. G., female, aged sixty-two, admitted November 10, 1930; discharged December 21, 1930. Four weeks' history of pain in the right upper quadrant. Complete block of common duct for three days. Icteric index, 40. Clotting factors: prothrombin, 1.1; fibrinogen, 1.04 per cent; antithrombin, 1.0; index, 1.1. Pre-operative prognosis in reference to post-operative hæmorrhage: "Clotting factors normal. Prognosis good." This patient received liver-extract as pre-operative preparation. It seemed to me that liver-extract might improve the post-operative course of the jaundiced patient. Furthermore, I have noticed in two cases that moderate post-operative bleeding stopped after the use of liver-extract. Clotting factors before operation were (November 24th): prothrombin, 0.91; fibrinogen, 1.12 per cent.; antithrombin, 1.25; index, 0.8. Pre-operative prognosis in reference to post-operative hæmorrhage: "Good." Operation (November 24th) revealed one very large stone in the common duct. Patient made a good recovery.

Case II. No. 319994.—M. E., female, aged forty, admitted November 3, 1930; died November 17, 1930. Deep jaundice for six weeks. Stools completely acholic. Mass in right upper abdomen. Temperature normal. Bleeding time, three minutes; clotting time, seven minutes. Clotting factors: prothrombin, 0.6; fibrinogen, 0.64 per cent; antithrombin, 1.22; index, 0.3. Pre-operative prognosis in reference to post-operative hæmorrhage: "Index is too low. Patient is apt to bleed." Exploratory laparotomy revealed a carcinoma of the pancreas with metastases in the liver. Post-operative course: Patient appeared in good condition for two days. On the third day a large hæmatoma with continuous oozing from the incision occurred. Patient was probably bleeding internally, too, as the pulse became very small and rapid. She died on the fourth day following the operation. No post-mortem examination. Undoubtedly, the bleeding played an important rôle in hastening the fatal outcome.

Case III. No. 319809.—R. E., female, admitted October 28, 1930; discharged November 30, 1930. Very deep jaundice for one month without fever. Bleeding time, three minutes; coagulation time, five minutes. Icteric index, 175; sedimentation time, 30 minutes. Clotting factors: prothrombin, 1.0; fibrinogen, 0.94 per cent.; antithrombin, 1.03; index, 1.0. Pre-operative prognosis in reference to post-operative hæmorrhage: "Patient presents normal figures. She is not apt to bleed following the operation."

Operation (November 3rd) revealed two stones in the common duct. Gall-bladder very small without stones. Drainage of common duct. Uneventful recovery. This patient on account of her very deep jaundice looked clinically like a very poor operative risk, in whom post-operative hæmorrhage was most likely to occur.

CASE IV. No. 320173.—G. B., male, aged fifty-five, admitted November 9, 1930; died November 17, 1930. Painless jaundice for two months, afebrile course in the hospital. X-ray examination shows deformed duodenal cap, probably due to malignancy of the common duct. Bleeding time, one minute; coagulation time, nine minutes. Icteric index, 180. Clotting factors (November 12): prothrombin, 0.66; fibrinogen, 0.94 per cent.; antithrombin, 1.18; index, 0.5. Pre-operative prognosis in reference to post-operative hæmorrhage. "Patient's index shows that he is apt to bleed after the operation." This patient, who had no bleeding during his illness, suddenly showed tarry stools on November 15. He went into collapse and died about thirty hours later, despite a transfusion. No postmortem examination.

CASE V. No. 320326.—R. O., male, aged sixty-three, admitted November 13, 1930; discharged January 21, 1931. Private patient of Doctor Berg. Since four months very deep jaundice with greenish discoloration of skin, afebrile course. Coagulation time nine minutes. Clotting factors (November 16): prothrombin, 0.81; fibrinogen, 1.14 per cent.; antithrombin, 1; index, 0.8. Pre-operative prognosis in reference to post-operative hæmorrhage: "Fair." Operation (November 22): Gall-bladder contains many stones. One stone in common duct, at papilla of Vater. Cholecystectomy and choledochotomy with drainage of common duct. Uneventful recovery.

CASE VI. No. 321935.—S. L., male, aged fifty-three, admitted January 8, 1931; died January 15, 1931. Had slight attack of jaundice nine months ago, recurrence seven months ago, severe jaundice with chills and fever for two weeks. Bleeding time, two minutes; coagulation time, four and one-half minutes. Tourniquet test, negative; icteric index, 140. Clotting factors (January 12, 1931); prothrombin, 0.64; fibrinogen, 1.3 per cent. antithrombin, 1.33; index, 0.6. Pre-operative prognosis in reference to post-operative hæmorrhage: "Patient has a low prothrombin and a high antithrombin. He is apt to bleed." The patient received a blood transfusion (300 cubic centimetres of citrated blood) five hours before the operation. Another test for clotting factors was done immediately before the operation. This second test showed the following figures: prothrombin, 0.78; fibrinogen, 1.3 per cent.; antithrombin, 1.18; index, 0.9. Conclusions of the Fifth Avenue Hospital Laboratory: "This patient's index has come up. However, he may still bleed after the operation, as it is impossible to say how long the effect of the transfusion will last." Operation revealed a carcinoma of the gall-bladder with metastases in the liver and a large intrahepatic abscess. Probatory excision of a piece of the liver. Carcinoma. Drainage of abscess. This patient vomited a pint of blood on the day following the operation and died shortly afterwards. Post-mortem examination confirmed the operative findings. Prognosis in this case was very accurate. The improvement of the blood-clotting factors following the transfusion was temporary and did not prevent the fatal profuse post-operative hæmorrhage to which the patient succumbed.

CASE VII. No. 322274.—M. L., male, aged sixty-six, admitted January 19, 1931; died February 9, 1931. Ten weeks' history of jaundice with pains in right upper abdomen. Practically afebrile course. Bleeding time, two minutes, ten seconds; clotting time, eleven minutes. Icteric index, 45. Sedimentation time, seventy minutes. Clotting factors (January 27): prothrombin, 0.81; fibrinogen, 0.94 per cent.; antithrombin, 1.11; index, 0.7. Pre-operative prognosis in reference to post-operative hæmorrhage: "Patient is a fair risk. He may bleed some." In view of the rather doubtful prognosis as to bleeding tendency a citrate transfusion was given before the operation. Clotting factors determined immediately after the transfusion showed the following figures (January 28): prothrombin, 0.88; fibrinogen, 0.94 per cent.; antithrombin, 1.03; index, 0.8. Prognosis: "Clotting factors improved. Patient should be a good operative risk at

present." Operation (January 29): Choledochotomy for stone. Gall-bladder small, without stones; was left *in situ*. The common-duct stone was removed through a small incision into the duct. Drainage of the duct by a tube. Patient began to ooze moderately through the abdominal incision on February 2. On the next day biliary drainage contained a large amount of blood. Another transfusion was given on February 3. The tube was removed on February 4, in order to prevent clot formation in the common duct. February 4: icteric index, 110. Another test for clotting factors (February 4) showed the following figures: Prothrombin, 0.66; fibrinogen, 1.3 per cent.; antithrombin, 1.25; index, 0.7. "Tests show bleeding tendency. Prothrombin very low." The sedimentation test was repeated on February 4. It had fallen from seventy to twenty minutes. Patient's condition became gradually worse. He died February 9. Postmortem examination showed the common duct free, without stones or blood clot. Hæmatoma and localized peritonitis in the right upper quadrant. Cause of death: cholæmia and localized peritonitis.

TABLE

Review of Clotting Factors in Seven Cases of Jaundice

CASE I.—November, 1930.—Marked jaundice for three weeks; icteric index, 40; large stone in common duct. Prothrombin, 1.1; fibrinogen, 1.04 per cent.; antithrombin, 1.0; index, 1.1. Prognosis as to post-operative hæmorrhage—good. Operation.—Choledochotomy for stone. Result—Well.

CASE II.—November, 1930—Deep jaundice for six weeks; carcinoma of the pancreas with liver metastases. Prothrombin, 0.6; fibrinogen, 0.64 per cent.; antithrombin, 1.22; index, 0.3. Prognosis as to post-operative hæmorrhage.—Bad. Operation.—Exploratory laparotomy. Result.—Died of hæmorrhage. No postmortem examination.

CASE III.—November, 1930.—Deep jaundice for one month; icteric index, 175; common-duct stones. Prothrombin, 1.0; fibrinogen, 0.94 per cent.; antithrombin, 1.03; index 1.0. Prognosis as to post-operative hæmorrhage.—good. Operation.—Choledochotomy for stones. Result.—Well.

CASE IV.—November, 1930.—Deep jaundice for two months; icteric index, 180; carcinoma of the pancreas. Prothrombin, 0.66; fibrinogen, 0.94 per cent.; antithrombin, 1.18; index, 0.5. Prognosis as to post-operative hæmorrhage.—bad. Operation.—None. Result.—Died of cholæmia and post-operative hæmorrhage. No postmortem examination.

CASE V.—November, 1930.—Deep jaundice for four months; cholelithiasis and common-duct stone. Prothrombin, 0.81; fibrinogen, 1.11; index, 0.8. Prognosis as to post-operative hæmorrhage.—good. Operation.—Cholecystectomy and choledochotomy for stones. Result.—Well.

CASE VI.—January, 1931.—Deep jaundice with fever and chills for two weeks; two previous attacks; icteric index, 140; carcinoma of the gall-bladder with metastases in the liver. Prothrombin, 0.64 before transfusion.—0.78 after transfusion; fibrinogen, 1.3 per cent. before transfusion.—1.3 per cent. after transfusion; antithrombin, 1.33 before transfusion.—1.18 after transfusion; index, 0.6 before transfusion—0.9 after transfusion. Prognosis as to post-operative hæmorrhage.—bad. Index improved after transfusion. Impossible to say how long effect of transfusion will last. Still considered bad risk. Operation.—Exploratory laparotomy. Result.—Died of hæmorrhage; postmortem examination.

CASE VII.—January, 1931.—Marked jaundice for ten weeks; icteric index, 40; February 5: iteric index, 110; stone in common-duct; choledochotomy. Prothrombin: January 27, 0.81; January 29, 0.88; after transfusion February 4, 0.66. Fibrinogen: January 27, 0.94 per cent.; January 29, 0.94 per cent.; February 4, 1.3 per cent. Antithrombin: January 27, 1.11; January 29, 1.03; February 4, 1.25. Index: January 27, 0.7; January 29, 0.8; February 4, 0.7. Prognosis as to post-operative hæmorrhage.—January 27, doubtful; January 29, good; February 4, bad. Operation.—January 29,

choledochotomy for stone. Result.—Post-operative bleeding. February 9, died of cholæmia, hæmorrhage and infection in right upper quadrant.

The material presented herewith comprises seven cases—three of malignancy and four of common-duct stones. The three cases of malignancy died, two following operation. Among the four cases of common-duct stone one succumbed to post-operative bleeding. The other three patients made an uneventful recovery in spite of the fact that they showed deep jaundice. Their blood figures were normal. Pre-operative clotting-factor tests showed that the three cases of malignancy had a bleeding tendency. They succumbed to hæmorrhage and cholæmia. Clotting-factor determinations in Case VII (common-duct stone) showed some tendency to bleed. After a pre-operative blood transfusion the index indicated a good operative risk. This patient began to bleed on the fifth day following the operation. Renewed tests showed a marked hæmorrhagic tendency, evidently due to progressive jaundice. (The icteric index had mounted from 45 to 110.)

The index is arrived at by multiplying prothrombin with fibrinogen and dividing it by the antithrombin If the index is 0.7 or above that figure, the prognosis as to hæmorrhage seems to be good. When the index is below 0.7, hæmorrhage may complicate the post-operative course.

It is possible that prothrombin and antithrombin without fibrinogen determination may be a sufficient indicator for a hæmorrhagic tendency. Fibrinogen figures rise in the presence of infection, a very frequent complication in jaundice. The cases reported above ran a practically afebrile course, with the exception of Case VI. Presence of fever and infection may interfere with the correctness of the fibrinogen figures as a factor in the determination of hæmorrhage tendency. Linton has recently used the sedimentation rate of the blood as an indicator for possible post-operative hæmorrhage in jaundiced patients. A sedimentation rate of less than 30 millimetres in thirty minutes is considered slow, whereas a rate of more than 30 millimetres in thirty minutes is considered rapid. When using this method in jaundiced patients he could predict post-operative hæmorrhage when the rate was rapid, whereas a slow rate indicated a good operative risk. We expect to use both methods (sedimentation rate and clotting-factor determination) in a series of cases, in order to compare their accuracy.

Sedimentation rate is used extensively, especially on gynæcologic services, as an indicator of the presence or absence of acute infections. Therefore it seems *a priori* that in cases of jaundice with fever and secondary infection of the biliary system, the figures would not be absolutely reliable as a clotting index. They are probably strongly influenced by another factor, namely, acute infection.

I appreciate that no definite conclusions can be drawn as to the value of the prothrombin, fibrinogen and antithrombin tests for the subject under discussion. The number of jaundiced patients requiring surgical intervention is comparatively small in our hospital. This early report is made

in the hope that others will try the tests. Their apparent correctness in the seven cases reported herewith possibly may be pure coincidence.

Clotting-factor determinations also may be of importance in determining the value of different procedures which are used more or less empirically in the pre-operative preparation of this group of patients. Intravenous or intrarectal injection of glucose solution, blood transfusion, intravenous medication of calcium chloride, parathormone, high carbohydrate diet, *etc.*—they all have been used for a number of years in the attempt to improve the operative risk of these patients. No unanimity exists as to their value. For instance, Walters advocates calcium chloride for the reduction of prolonged coagulation time in the jaundiced patient. On the other hand, Ravdin, Riegel and Morrisson, in a very careful experimental study read at the joint session of these societies in 1930, concluded that administration of glucose caused shortening of the coagulation time, whereas calcium was ineffective in their experiments. If we could find a reliable hæmatologic test, such test could settle the value of these different methods of preoperative preparation of the patient. Instead of relying on general impressions, we might be able to establish definitely the value of certain forms of treatment and discard others which are in use at present.

Furthermore, such tests may be important in another direction. When dealing with deep jaundice due to a common-duct stone, many surgeons prefer simply to remove the obstructing calculus and to defer cholecystectomy to some later date. They are afraid that uncontrollable hæmorrhage may follow the dissection of the gall-bladder from the liver-bed. Undoubtedly it would be preferable to deal with the gall-bladder at the time of the primary operation, if we would know which cases are apt to bleed after the operation. As stated above, the degree and duration of the jaundice is not a definite indication. It is possible that pre-operative prothrombin and antithrombin determination may offer a valuable clue in this direction.

I beg to thank Dr. F. W. Bancroft and his staff for their most generous coöperation.

Since the presentation of this series eight additional cases have shown substantially the same results.

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DISCUSSION.—DR. F. S. RAVDIN remarked that the statement made by Doctor Lewisohn that hæmorrhage is the most frequent complication in

operations for ductal obstruction has not been borne out in the cases at the hospital of the University of Pennsylvania. Post-operative vasodepressor states and various types of asthenia have accounted for a larger number of their deaths. Under proper preliminary treatment the percentage of cases which bleed can be markedly reduced. There is no available evidence that calcium is of any value in these cases. The degree of jaundice, in their experience, is of very little prognostic value.

In regard to clotting time, if this is properly done it may be of some value. The method of Lee-White has in their experience been most reliable.

In their experience, the bile acids of the blood rapidly diminish after the second week of ductal obstruction so that they do not account for the bleeding.

He was wondering whether Howell, Minot and others had accepted the fact that antithrombin actually exists, and, secondly, what the error of the method described actually is? The error in the prothrombin and antithrombin estimations may be considerable, and since the mean error of the entire calculation is equal to the greatest error of any of its components, the differences here reported on which definite statements are made may be so small as to be worthless in the ordinary laboratory where work is not done with research accuracy.

He had calculated the indices to the second place and had added to the data which Doctor Lewisohn presented an additional case which Doctor Kugelmass reported in 1928.

Case	I	II	III	IV	V	VI
Prothrombin	0.6	1.0	0.66	0.81	0.64	0.31
Fibrinogen	0.64%	0.94%	0.94%	1.14%	1.3%	0.38%
Antithrombin	1.22	1.03	1.18	1.25	1.33	1.5
Index	0.31	0.91	0.53	0.74	0.63	0.078

He would like to know why the sixth case did not bleed to death during one of her previous pregnancies. A complete report of this case can be found in the Journal of the American Medical Association, 1928.

As to the effect of a protein or fat diet in jaundiced patients, one is treading on very dangerous ground with no evidence that a calcium deficiency exists in jaundice. One can easily demonstrate that such a diet increases liver injury.

He was inclined to believe that sufficient data had not yet accumulated to warrant the assumption that accurate prognosis in regard to hæmorrhage can be obtained from data such as have been presented.

MESENTERIC VASCULAR OCCLUSION

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MESENTERIC vascular occlusion, which in its acute form is one of the most baffling conditions with which a surgeon has to deal, was first described by Triedman in 1843. Virchow in 1847 described the pathology and Elliott in 1895 performed the first successful operation for this condition. In 1904, Jackson, Quinby, and Porter[55] reported a 92 per cent. mortality in twenty-seven collected cases. Trotter[60] in 1914 reported that only 4 per cent. of three hundred and sixty-six cases were correctly diagnosed. The operative mortality in this group was 63.8 per cent. Klein[59] in 1921 stated that there was record of only twenty-four successful operations in about five hundred cases. This background and comment on a case in my own experience has stimulated an analysis of the literature of the past ten years to gather information which might shed some light on earlier diagnosis or better management of the disease.

It soon became apparent that a knowledge of the etiology was necessary to attract attention to the possibility of the disease and a knowledge of the pathology in order that the condition would not pass unrecognized at operation. Therefore, a summary of the etiology and of the pathology as found at operation would not be amiss in this paper.

Accurate statistics are not available to determine the frequency of the disease because many cases pass unrecognized. Ten per cent. in this series were overlooked at operation. Sheehan[9] states that at the Massachusetts General Hospital there were only thirteen cases in approximately 48,000 surgical admissions, and Ross reports only two cases in 30,000 admissions at the Lankenau Hospital. Loop[28] encountered nine cases in three years, Johnson[56] six cases in five years, and Watson[57] eight cases in one year.

The disease may occur at any age. The youngest patient in this series was four months.[31] The oldest was seventy-nine years of age. Bruns[5] reported one instance in a child eleven years old, and Frank[17] reported three cases in which the ages were eight, ten, and twelve years.

In the majority of instances there is some disease of the circulatory system as endocarditis, arteriosclerosis, atheroma, aneurism, phlebitis, or stasis of the portal system. There may be a history of trauma or of hernia, but at times there may be no demonstrable etiological factor. In this series there were three patients with polycythæmia, and one with hæmophilia. Seven cases followed appendicitis operations, and two were associated with acute appendicitis.

The results of obstruction of the mesenteric vessels vary. Rarely, the occlusion may be complete without any abdominal symptoms or demonstrable changes in the intestine as in two of Brady's[4] and one of Trotter's[60] cases. Occasionally, the blood supply to the parts may be sufficient for life but not

for function as in the case of Reed,[43] Jopson,[25] Garcia,[18] and of Davis.[13] Klein[59] found eight cases of spontaneous recovery reported and added one of his own. In the majority of cases the obstruction leads to hæmorrhagic infarction, or deep engorgement with later ulceration and perforation. Anæmic infarct rarely occurs. It was present in three instances in this series and in 2 per cent. in Trotter's.

The first group does not concern the surgeon, but recognition of the second and third group is imperative. The second group presents the most difficulties. In this group the capillaries and venules become enormously distended with blood but there is only slight extravasation into the layers of the intestine and destructive transformations have not set in. Upon examination of the bowel the color is variously described as gray, or yellowish-gray in the anæmic changes and as dusky, dark-red, blue-black, purple, mottled, or mahogany red when hæmorrhagic changes occur. There may be slight spontaneous peristalsis or a sluggish reaction to stimulation. The bowel is dilated and lacks tone but seldom is distended as in ordinary bowel obstruction. Neither does it have the tendency to force itself through the abdominal wound. The mesentery is usually engorged and free fluid may or may not be present in the peritoneal cavity.

It is in this group that more detailed information is necessary to enable one to determine positively whether or not a segment of bowel will recover function or if changes leading to death from toxæmia or gangrene will occur. In Garcia's case[18] there was gray color, lack of tone, and dilation of the bowel over a large area, yet recovery occurred promptly without resection. In Penniger's[40] case only one foot of bowel appeared anæmic and reacted sluggishly to stimulation; no resection was done and at post-mortem six days later this segment was found to be gangrenous. In one of Davis' cases[13] the entire small bowel seemed gangrenous, yet recovery occurred without resection, while in one of Cabot's cases[7] the color seemed to return but the bowel was found to be gangrenous the next day. Loop[28] had a similar experience. It is evident, therefore, that gross appearance is not a safe guide as to whether or not the bowel will recover. Davis'[13] case, however, gives a clew which may be of advantage in determining the viability of the intestine. In his case, which recovered without resection, he found, by puncturing the vessel near the bowel, that the blood was still fluid.

In the third group degenerative changes have begun. The bowel wall is greatly thickened, sometimes to the extent of occluding the lumen; it is œdematous and engorged with blood in all its coats. The bowel is dilated, heavy, filled with fluid and seldom distended. The bowel is held down by the weight of the fluid in its lumen and to the touch it gives the sensation of a filled rubber tube. The color is similar to the second group and the peritoneal coat may retain some of its lustre until a late stage. The motility of the affected bowel is absent or seriously impaired. The mesentery is heavy, thickened, congested, and feels doughy. Pulsation in the affected area is absent. The vessels may feel the same to the touch as thrombosed varicosed

veins. Free fluid is usually present in large amounts and varies in color from transparent amber to bloody. The fluid is odorless and usually contains no coagulated lymph.

In dealing with the symptoms leading toward a diagnosis, one is beset with considerable difficulties owing to the diverse forms under which the disease appears. In the majority of instances it is the final scene of a preceding protracted disease and is ushered in suddenly, without warning. The following symptoms occurred most frequently.

Pain was present in 100 per cent. of the cases where any intestinal changes occurred. It was usually severe from the onset, and constant with exacerbations. It usually originated around the umbilicus and then became general. A peculiar phenomenon which sometimes occurred was cessation of the pain soon after the onset only to recur a few hours or days later, the other symptoms meanwhile continuing unabated. Cramp-like pains in the vessels of the leg were noted in three cases.

Vomiting was stated to be present in 55 per cent. and absent in 10 per cent. of this series. It occurred soon after the onset of the pain and was repeated. Rarely was it present only at the onset, or only after the disease had existed several hours.

Nausea was definitely stated to be present in only 20 per cent. of the cases.

Blood in the stools was reported in 14 per cent. In three of these cases melæna did not occur during the first day. In one instance it did not appear until the twelfth day.

Diarrhœa was mentioned in 10 per cent.

Tenderness was reported as present in 55 per cent. and as absent in 8 per cent. of the cases. It varied in degree from just perceptible to very acute.

Rigidity was listed as present in 16 per cent. and as absent in 15 per cent. Board-like muscular tension was not common.

Distention was present at some time in 45 per cent.

The temperatures reported ranged between 96° and 101° F. In the twenty-six cases in which the duration of the disease was twenty-four hours or less the temperature was reported twelve times. In eight of these it was below 98.6° F.

The pulse was reported in thirty-nine instances. It was normal or slow in fourteen. If the pulse was not rapid at the onset, it usually became so in a short time. In one instance the pulse was only sixty-eight seven days after the onset of acute symptoms.

The leucocyte count was reported in twenty-three instances. In all but three the count was above 18,000. The lowest report was 10,000 and the highest was 45,000. The increase is rapid and occurs very soon after the onset of pain.

Urine chemistry was given in three instances. In two of these indican was reported as four plus, and in the other urobilin was reported as three plus.

No blood chemistry findings before operation were recorded.

No X-ray examinations to determine presence of gas were recorded.

From an analysis of the symptoms definitely stated to be present or absent in the various case histories it is impossible to formulate any definite rule for an early diagnosis of the condition. Only two findings, abdominal pain and high leucocyte count, were constantly associated. However, from reading the reports of cases which were operated upon within twenty-four hours one gains the impression that severe abdominal pain, not relieved by an enema, and accompanied by vomiting, disturbed bowel function, and a high leucocyte count, with or without collapse, tenderness, rigidity, or distention should lead one to suspect a vascular lesion in the abdomen. This is especially true if any of the usual etiological factors are present.

These findings, except for the high white-cell count, are essentially the same as those found in early bowel obstruction. The hope for early treatment, therefore, would lie in recognition of an acute abdomen or in consideration of what justifies an exploratory laparotomy. Miller,[58] from a study of 343 cases of intestinal obstruction, concludes that any pain which is not relieved by a small dose of morphine, or which lasts more than six hours in a previously healthy patient justifies an exploration. Exploration should be done before peritonitis and toxæmia cloud the picture.

The treatment of partial occlusion as occurs in splanchnic intermittent claudication is medical, but when infarction occurs, the treatment is surgical. It is true that in some instances of occlusion, recovery takes place without resection, but this is rare, and as shown in the discussion on pathology in our present state of knowledge one cannot be positive as to whether or not the process will go on to gangrene. The logical procedure, therefore, is resection of the diseased area followed by an anastomosis immediately or at a later date.

While prompt interference is the fundamental factor of success, improper preparation may result in disaster. Pre-operative preparation should be directed to the relief of vomiting, the loss of chlorides, and fluid, and to the heart.

Vomiting is controlled by gastric lavage. This procedure, in addition to offering relief from vomiting, lessens the danger of pneumonia. The loss of chlorides and fluids is combated by saline hypodermically or intravenously. Salt therapy is not a treatment of the cause of the changes, nor is it effective in combating the toxæmia which develops from the autolysis of the diseased bowel. It helps only by replacing and preserving the elements of which the organism tends to deprive itself. This fact is shown by the experimental work of Wangensteen[61] and by Hubbards[22] blood chemistry report in an operated case in which no resection was done. This case received saline but showed a rapid and steady increase in the urea and non-protein nitrogen until death from toxæmia. No change in the alkali reserve occurred in this case.

The heart is stimulated by saline and digitalis. The saline by increasing the blood volume furnishes something for the heart to contract upon and the digitalis strengthens the beat and lessens the possibility of dilatation.

Although enterostomy and exteriorization have been resorted to in the treatment of vascular occlusion, one should not be satisfied with these pro-

cedures when gangrene is present or imminent. While enterostomy is often a life-saving procedure in simple obstruction, it is useless in mesenteric vascular occlusion because here we are dealing with a lesion which paralyzes the bowel and with a toxæmia from the absorption of autolytic products from the diseased segment. Enterostomy does not function in a paralyzed bowel, and neither enterostomy nor exteriorization prevents the autolysis or the absorption of autolytic products from the diseased area. These procedures alone or in combination were used ten times in this series and fourteen times in Trotter's[60] series. To this group may be added three cases which the author saw as a resident physician; in two an enterostomy was done and in the third an exteriorization. Death ensued in each instance except one. This was a case of Trotter's[60] in which the lesion was not sufficient to interfere with peristalsis.

Exploration alone was done seventeen times. There were six recoveries.[13, 18, 21, 25, 43] In two of these the transverse colon was involved and the collateral circulation through the gastrocolic omentum was undisturbed.

Drainage was done in two instances with one recovery. In this case[25] an abscess cavity formed about the diseased segment and six inches of bowel sloughed through the wound. Anastomosis was done at a later date.

The usual reason for not resecting is that the patient's condition is unable to withstand the trauma of operation, or that the area involved is too great. The danger of death from a properly conducted operation is much less than the danger of death from peritonitis or toxæmia if the diseased segment is not removed. That trauma of a well-conducted operation is slight is shown by the recovery of Mitchell's[33] patient who was operated upon in a moribund condition without anæsthesia. Several successful operations were done with only local infiltration of the anterior abdominal wall. One of McGuire's[32] patients went on to normal term after seven and one-half feet of bowel were resected when the patient was four months pregnant.

The amount of bowel which may be resected without after ill effects varies. Flint[54] in a study of fifty-eight cases of extensive resections for various causes found that the metabolic disturbances were usually slight when less than 375 centimetres of bowel were resected. In this series there were three cases in which almost the entire small intestine was successfully removed. Doerfler[16] resected all but 12 centimetres of the jejunum and 20 centimetres of the ileum and the patient was well six and one-half years later. Wulsten[52] resected all of the small bowel except 15 centimetres of jejunum and 10 centimetres of ileum. In Sjovall's[48] case only 50 centimetres of small bowel remained. X-ray examination in this case showed that the small bowel took a direct course to the ileocæcal valve.

Often the line of demarcation between the diseased and healthy bowel is not well defined and the question arises as to the amount which should be resected. Resection should include all of the diseased area of the bowel and mesentery and as far beyond as is necessary in order to obtain free bleeding

from the severed structures. Failure to remove sufficient mesentery may permit the thrombosis to spread.

In this series resection alone was done eleven times, with seven deaths. One of these deaths was attributed to heat prostration, one was due to pulmonary embolism, and in one there was an incomplete resection.

Resection with some form of anastomosis was done thirty-two times with twenty-five recoveries. Two recoveries occurred in children.[5, 17] In addition to the three cases where almost the entire small intestine was removed, there were two cases in which more than 200 centimetres were removed.[32, 36] There was one death in this group from an extension of the diseased area after resection. It was the only case in which extension occurred after operation. The site of the thrombosis in this instance was the junction of the splenic and superior mesenteric vein.

Personal Case.—The patient, a white woman, aged sixty-two years, had suffered from constipation and indigestion all her life. She had a suspension and appendectomy years ago, a thyroidectomy in 1925, and gave history of passing a kidney stone in 1927. During the past year she suffered from a severe throbbing pain in the left lower quadrant which would last from a few minutes to hours and then recur days to months later.

February 18, 1930, at 2:00 A.M., the patient was awakened by severe cramp-like pains in the upper abdomen, more marked on the left side. The severe pains persisted for two hours and then slowly subsided, disappearing entirely by 7:00 A.M. Vomiting occurred twice at the onset of the pain. Nausea was constant. Rectal tenesmus was also present and was not relieved by a spontaneous bowel movement nor by an enema.

The patient was not examined until 1:00 P.M. February 18, at which time she was comfortable except for slight nausea. Pulse 60, temperature 98°, respiration 18. Heart and lungs normal. The abdomen was soft, not distended nor rigid. There was slight tenderness over the gall-bladder and sigmoid areas. No medication was given.

At 4:00 P.M. the patient was again seized with excruciating pain which was constant with exacerbations and was more marked in the lower left quadrant. At 5:00 P.M. the temperature was 96° F., the pulse 52. There was extreme tenderness and rigidity throughout the abdomen, but there was no distention. No vomiting, bowel movement or urination since early morning. The patient was sent to the Mercy Hospital with a diagnosis of bowel obstruction but she would not consent to operation.

At 6:30 P.M., the temperature was 98°, pulse 92 and respiration 20. Enema was ineffectual; only a small amount of mucus was returned. White blood count was 23,000. About 7:30 P.M., distention appeared over the bladder area. The patient was catheterized but only 1 ounce of urine was obtained; this specimen contained no red or white cells. At 9:00 P.M. she consented to operation. The distention increased, and she rapidly became worse and went into shock. Because of the severity of the symptoms the diagnosis was changed to mesenteric thrombosis. By the time she reached the operating room, no pulsation could be felt in either wrist or in the temporal region. Heart sounds were audible, extremely rapid and weak.

It was felt that the patient certainly would die without, and might survive with an operation. Therefore, local infiltration of the anterior abdominal wall was done simultaneously with stimulation of the circulation. Stimulation consisted of one ampule of digifolin intravenously repeated at the time the incision was made. Caffeine sodium benzoate intramuscularly, 1,000 cubic centimetres saline subcutaneously and 250 cubic centimetres glucose with insulin intravenously.

Upon opening the abdomen a large amount of bloody fluid escaped. The affected bowel was dilated, dark red to black, and remained inert in the abdominal cavity. There

was no peristalsis, either spontaneous or after manipulation. The bowel walls were thickened. The bowel above and below the diseased area was dilated and lighter in color than normal; peristalsis occurred after manipulation in this area. About 60 centimetres below the thrombosed area approximately 30 centimetres of bowel was caught in an adhesive band. This segment was moderately distended and discolored. The band was severed and the bowel immediately returned to normal appearance. The mesentery of the thrombosed bowel was found to be dark red, swollen and rather tense down to its base. The infarcted area which began about 45 centimetres from the duodeno-jejunal junction was resected and sufficient healthy tissue was removed to insure free bleeding from the edges of the bowel and mesentery. A lateral anastomosis was done without the use of clamps and without drawing the bowel from the abdominal cavity. Two gutta percha drains were inserted and the wound closed.

Post-operative Course.—The pulse could not be counted at the wrist until fourteen hours after the operation. Sixteen hours after operation the first urination occurred. Vomiting which occurred several times between the fortieth and forty-fourth hours was controlled by single gastric lavage. Flatus and spontaneous bowel movement occurred at forty-eight hours after operation.

Medication consisted of digifolin, 1 ampule every two hours for forty-eight hours, then every four hours for a similar period. Caffeine sodium benzoate was given every three hours for forty-eight hours. During the first twenty-four hours, 3,000 cubic centimetres of saline were given under the skin and 500 cubic centimetres of glucose with insulin were given into the vein. During the next forty-eight hours 3,000 cubic centimetres of saline and 1,000 cubic centimetres of glucose with insulin were given.

The specimen removed was measured the next morning and found to be 230 centimetres long. Microscopic examination revealed diffuse infiltration of all layers with serum and blood cells. The blood was coagulated in both the arteries and veins of the bowel and mesentery.

It is now one year since the operation and the patient is in good health, working every day.

SUMMARY

This paper is based upon a review of ninety-two proven cases of mesenteric vascular occlusion which have been reported during the past ten years. There were thirty-nine recoveries and fifty-three deaths, or a gross mortality of 57.6 per cent. In nine instances spontaneous recoveries occurred. In three of these cases the occlusion apparently did not cause any abdominal symptoms and the condition was found only at autopsy. In six instances the symptoms were sufficient to warrant laparotomy but no resection was done. There was one instance of sloughing of the diseased segment through the drainage wound. There were forty-three cases in which operative resection was done. The mortality in this group was 32.6 per cent. Recoveries include three cases of practically complete removal of the small intestine.

No definite symptom complex can be formulated, but the onset of acute abdominal pain not relieved by enema, accompanied by high leucocyte count, disturbed bowel function with or without collapse, tenderness, and rigidity in the presence of a disease of the circulatory system should lead one to suspect mesenteric vascular occlusion.

One cannot tell from the color of the bowel whether or not it will recover function. Enterostomy apparently is of no value in this condition. Resection of the diseased area offers the patient the best chance for recovery. In this

series the highest percentage of recoveries occurred in the group in which resection and immediate anastomosis were done.

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ORCHIOPEXY FOR UNDESCENDED TESTICLE*

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In November, 1909, I published a method of operating in cases of undescended testicle, the title of the paper being "The Technic of Orcheopexy."† Under this heading the article was practically buried, as physicians wishing to obtain information on the treatment of undescended testicle would not be likely to look for that title. In the last few years, however, the profession have taken an interest in the procedure, therefore I have had drawings made which demonstrate it more precisely than did the operating-room photographs in the earlier article. This operation has been employed by me since 1906, and, as every one of the cases has had a perfect result in placing the testicle where it normally belongs, I have not had the courage to try any other method.

The operation consists in laying bare the testicle, thinning down the cord till it consists of nothing but vas deferens and spermatic vessels and continuing the dissection of the vessels upward as far as necessary to allow the testicle to come well down without traction; then, after bringing the testicle out through an incision at the bottom of the scrotum and carrying it through a corresponding incision in the skin of the thigh, it is fastened to the fascia of the thigh, and the rudimentary scrotum is fastened to the skin of the thigh. After it has been anchored there for a couple of months, it is released and placed into the scrotum.

Now, as to the details of the method. The skin is prepared according to any of the approved methods. The sterilization of the skin is just as

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† As there exists a good deal of confusion regarding the correct form of this word, I venture some remarks relevant to the question. The names found in literature are "orchidopexy," "orcheopexy" and "orchiopexy." Of these three, "orchidopexy" must drop out of the consideration, inasmuch as the Greek word ὄρχις, meaning testicle, has no such genitive as ὄρχιδος (see Standard Greek-English Lexicon, Liddell and Scott). Its genitive occurs in two forms, ὄρχιος and ὄρχεως, of which the former is the older form. Etymologically, therefore, both "orcheopexy" and "orchiopexy" are correct. The choice then will depend on usage governing the form of English words derived from the Greek, and on that question Professor Brownson, the head of the department of classical languages and literature of the College of the City of New York, has enlightened me as follows: All Greek derivatives from words having the two forms of genitive as above, retain the older spelling with ι, and English has followed suit in its borrowings, thus from φύσις, nature, the genitive endings of which are εως, εος and ιος, we get "physiology," not "physeology," and numerous other examples show that usage decides in favor of ι. My original spelling, orcheopexy, should therefore be changed to orchiopexy.

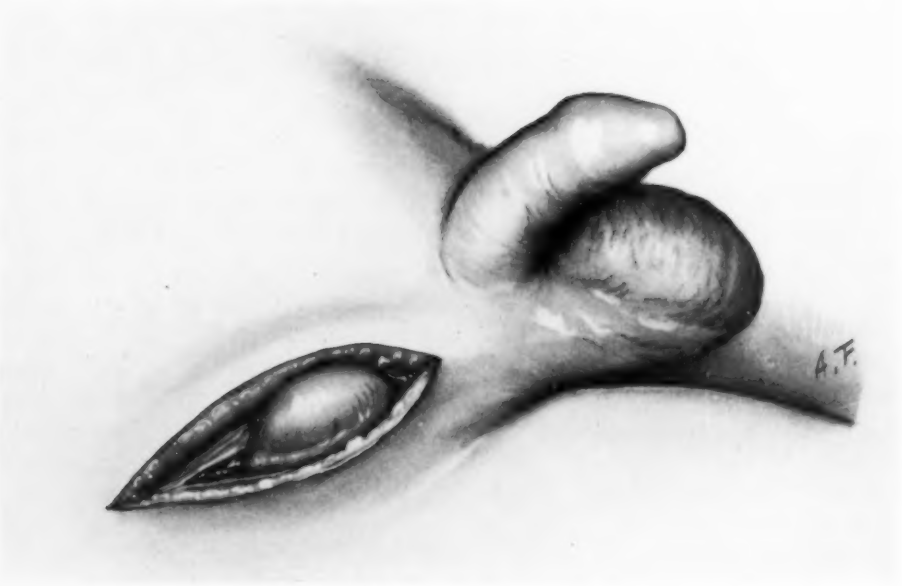


FIG. 1.—The testicle has been exposed by an incision over the inguinal canal.

FIG. 2.—The testicle has been liberated. The gubernaculum, the vaginal process and the cremaster fibres have been removed. The cord has been dissected out, revealing its important elements; the vas is seen at the lower, innermost part; the artery and veins farther up. They are seen to be separate, because the connective tissue, which otherwise unites them into a single cord, has been removed. Only one strand of connective tissue has been left for the purpose of demonstrating an important point; it is seen at the left, next to a vein, and is fairly tense, while the vein is partly curled up. It prevents the vessel from stretching out to its full length. After the removal of that strand the vein was lengthened by at least 2 centimetres.

FIG. 3.—Selection of the site for the incision in the thigh. The testicle is lifted out of the inguinal wound and laid on the thigh. A point somewhat higher than the one to which the testicle reaches is chosen for the incision, the direction of which follows the natural lines of the skin and therefore is in a general way transverse, the inner end slightly lower than the outer.

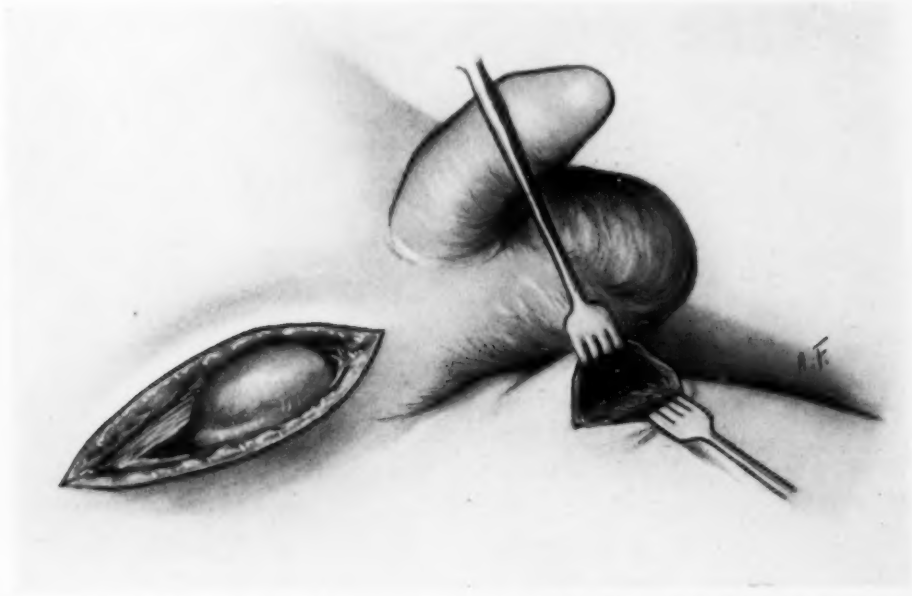


FIG. 4.—The incision is held open by retractors to expose the fascia of the thigh. The testicle has been replaced into the inguinal wound.

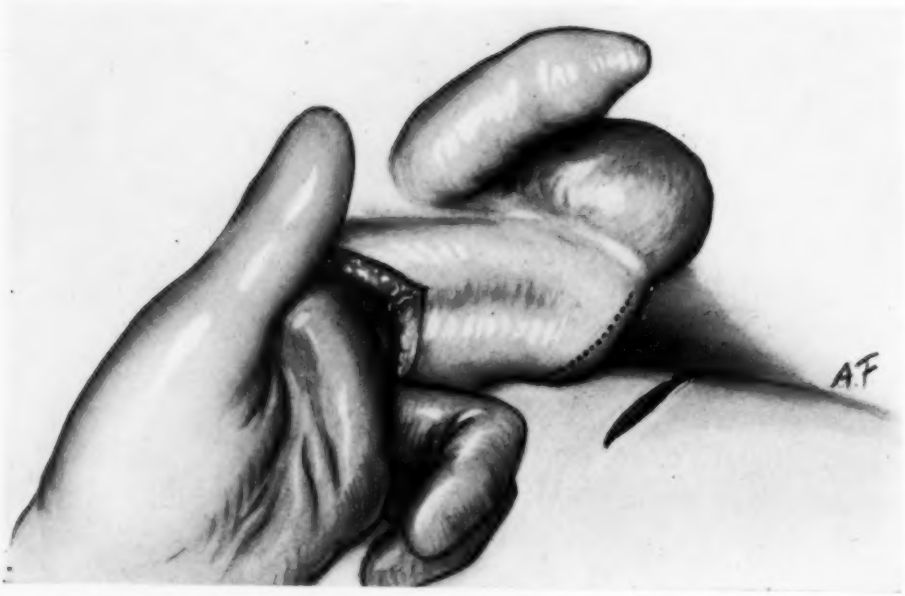


FIG. 5.—A channel is being made by insinuating two fingers into the loose connective tissue between the lower end of the inguinal incision and the bottom of the scrotum. Under the guidance of these fingers an incision is made in the scrotum corresponding in length and direction to that in the thigh.

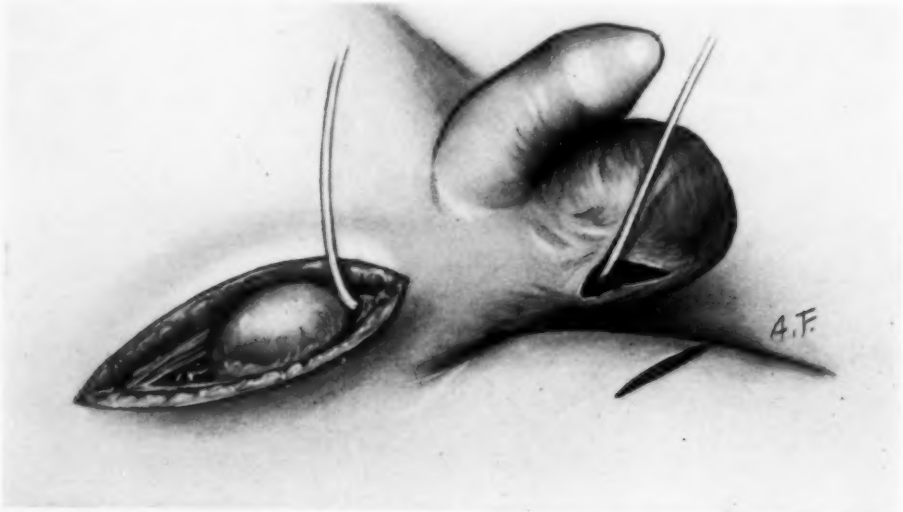
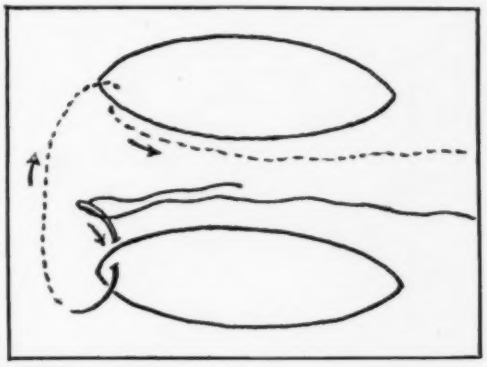


FIG. 6.—On withdrawing the fingers (Fig. 5) from the scrotum, a tape has been carried along, in order that the newly made channel should not get lost.

important in this part of the body as anywhere else, if not more so. The incision through skin and aponeurosis of the external oblique muscle is identical in location and extent with that employed in the operation for inguinal hernia. (Fig. 1.) A small incision, just big enough to expose the testicle, is not sufficient; the exposure of the inguinal canal must be wide enough to permit an extensive dissection of the cord without injury to the vessels.

The liberation of the testicle and of the essential parts of the cord is important. Gubernaculum, cremaster, and any other tissues that may be attached to the testicle are separated. Of the cord the only structures that must be preserved intact are the spermatic blood-



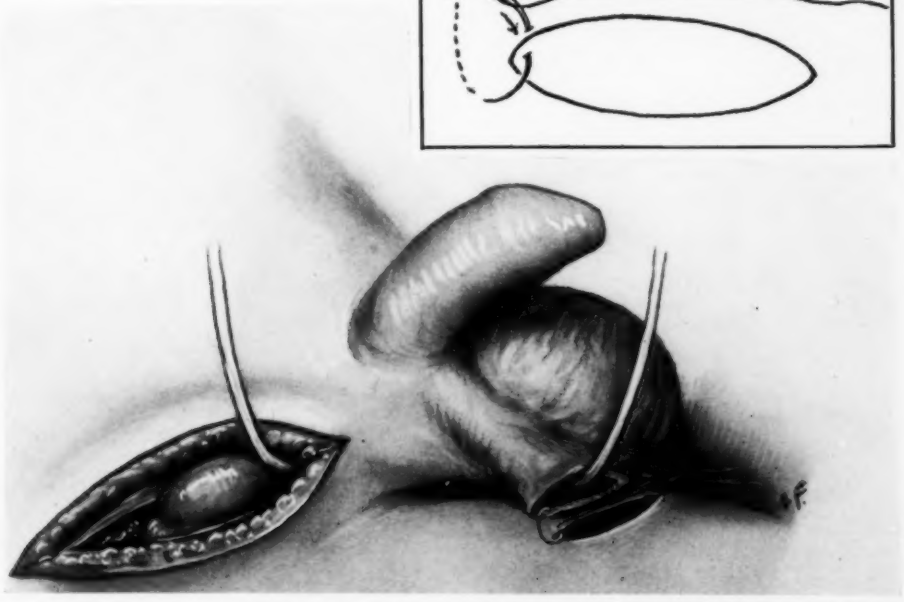


FIG. 7.—Suture of the posterior edge of the scrotal wound to the upper edge of the thigh wound. The suture embraces but little of the skin, more of the raw surface. Insert shows the needle at the place of its first insertion, the dotted line indicates the continuation of its course. In this way the knot comes to be placed on the skin surface. A superficial glance at this diagram might lead one to think the suture had been begun on the wrong side.

vessels and the vas deferens. All other tissues are to be removed, including the vaginal process. If there exists a congenital hernia, it is found in the vaginal process. When there is no hernia but only an empty, obliterated vaginal process, there is no sense in tying it off; it is cut off and the stump allowed to slip back into the abdomen. If there is a hernia or an open communication with the peritoneal cavity, the sac is tied before being amputated. The vas deferens and blood-vessels are denuded of all their connective-tissue coverings till they are the sole remnants of the cord. The dissection of the

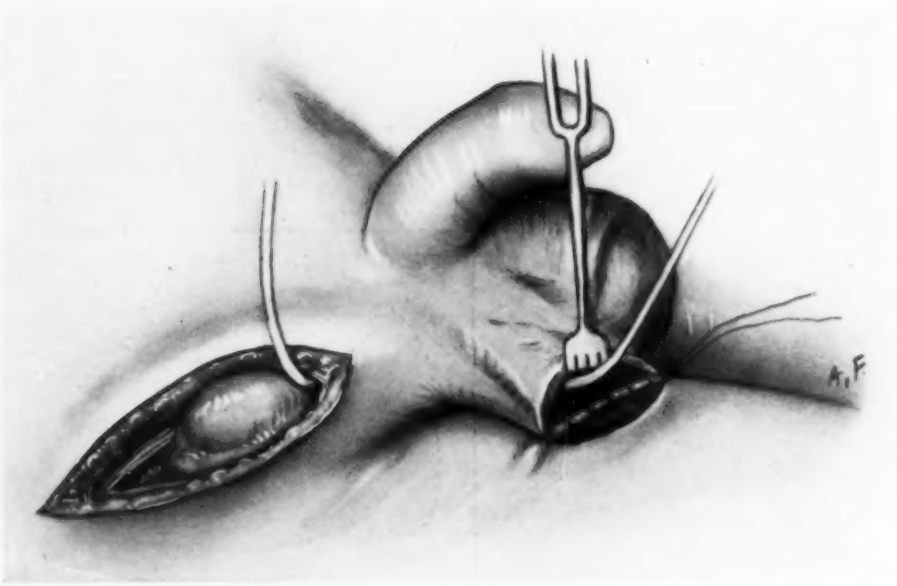


FIG. 8.—The entire posterior lip of the scrotal wound has been united with the upper edge of the thigh wound. All sutures were cut after tying the knot; the last one, at the mesial end, is still seen.

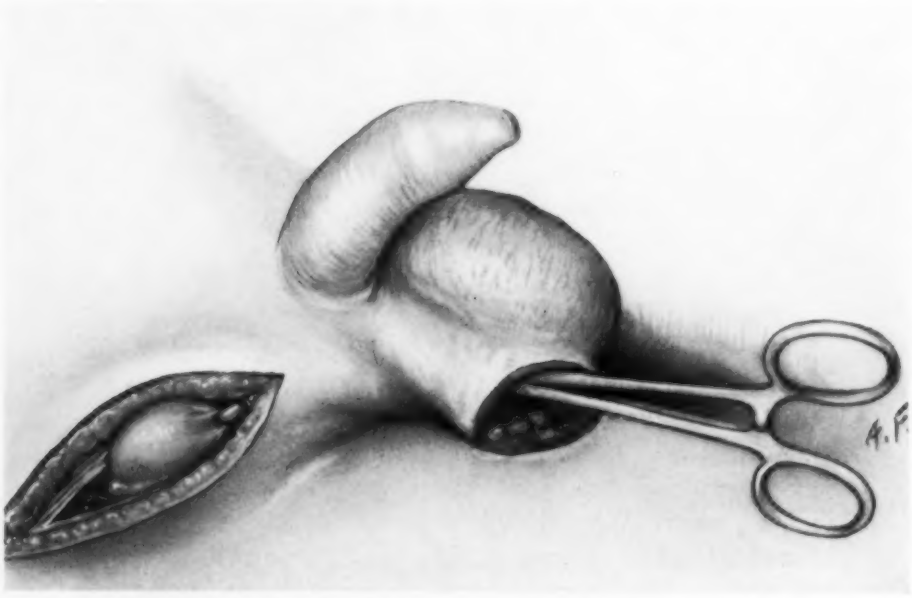


FIG. 9.—Under guidance of the tape which was grasped by the clamp outside of the scrotal wound, the mouth of the clamp has been carried into the inguinal wound, where it grasps a small portion of the tunica propria testis, at the place where the gubernaculum was cut off.

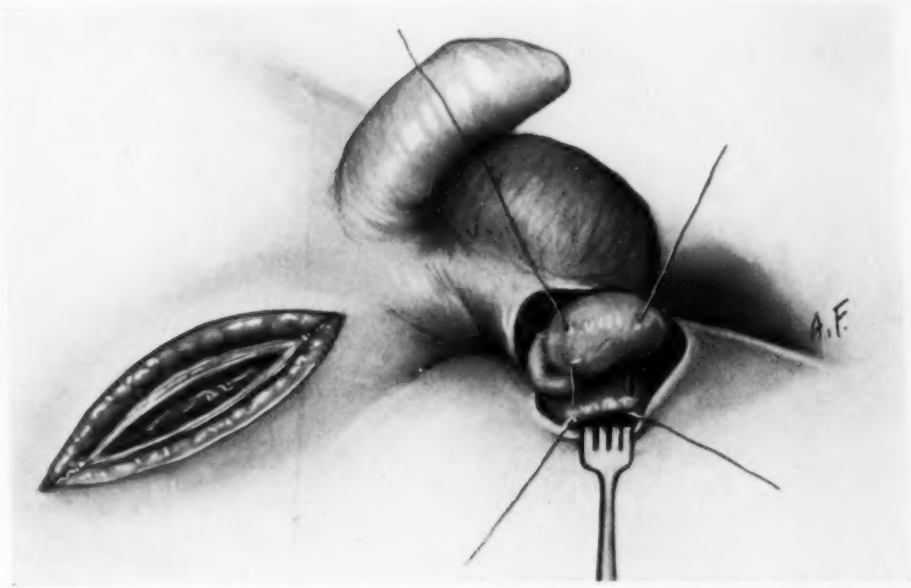


FIG. 10.—The testicle has been drawn down by the clamp and two sutures have been inserted to fasten it to the fascia of the thigh.

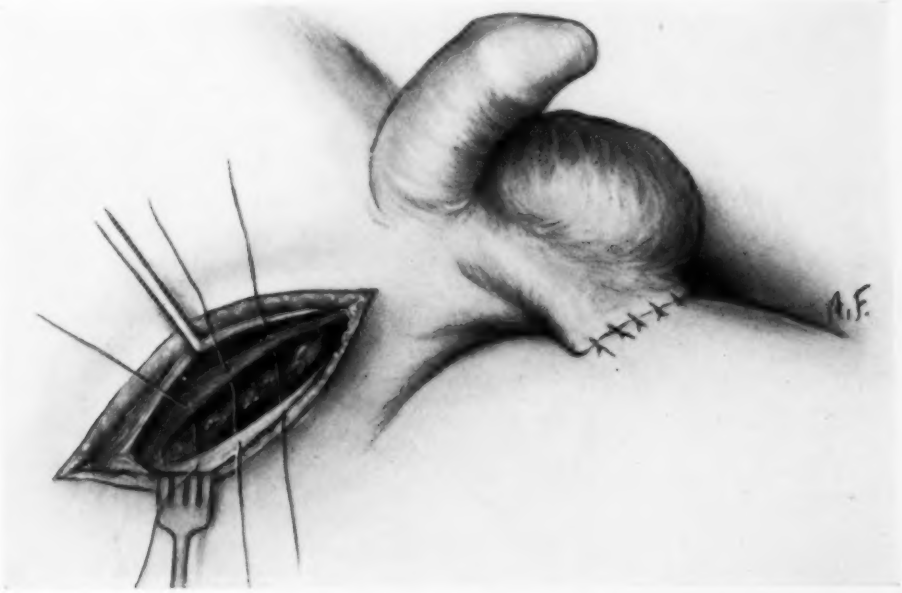


FIG. 11.—The testicle having been attached to the fascia, the skin is closed over it. In the inguinal wound, sutures have been passed through the internal oblique and transversus muscles above and Poupart's ligament below. The aponeurosis of the external oblique is held back, above by a clamp, below by a retractor which partly conceals it.

FIG. 12.—The operation is completed. A strip of gauze lies in the canal of skin between scrotum and thigh; it serves as a dressing for the deep suture.

FIG. 13.—The completed second stage in a case of bilateral retention of the testicles. In this stage the left testicle, which had been brought down at the first stage, was liberated from the thigh and the wounds were sutured, after which the operation on the right testicle was performed. The left inguinal scar is visible in the illustration and so are the sutures in the left half of the scrotum; the suture of the wound in the left thigh is almost completely hidden.

vessels should always extend as high up as the transversalis fascia, and still higher if they are not yet long enough. Fig. 2 shows the cord dissected out, the vas deferens lying below, the artery and veins farther up. They are seen to be separate, because the connective tissue, which otherwise connects them into one strand, has been removed. Only one strand of connective tissue was left in place when the photograph was taken, in order to show how it interfered with the straightening out of the adjoining vein. The removal of such strands promptly gives the blood-vessel greater length, without any traction. If the vessels have been dissected to a point high up and laid absolutely bare of connective tissue, the testicle can be brought down far enough.

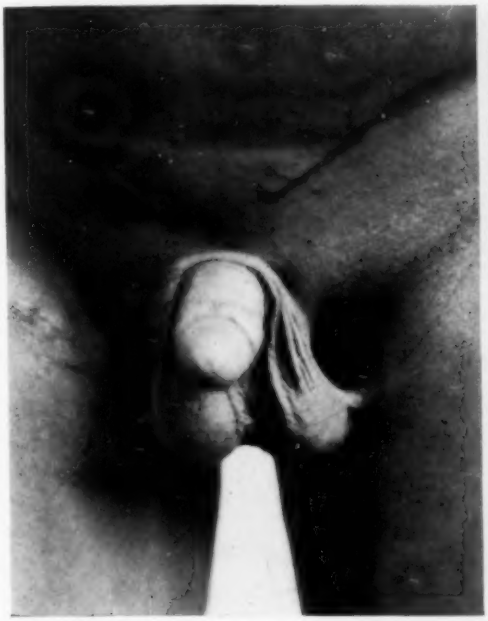


FIG. 14

FIG. 15

FIGS. 14 and 15.—A case of bilateral ectopy in which the first stage, bringing down the right testicle, and the second stage, releasing the right testicle and bringing down the left, have been performed. The scrotum, which previous to the first operation was but a rudimentary piece of skin close up at the perineum, shows proper development. The scars in both inguinal regions and on the right thigh can be seen.

The site for the incision in the thigh will sometimes be higher, sometimes lower. It is determined by taking the testicle out of the inguinal wound and laying it on the thigh without any traction beyond that which is necessary for straightening out the vessels. The place where the testicle touches the thigh, somewhat higher than the lowest point reached by it, is chosen. (Fig. 3.) The site having been selected, the testicle is laid back again into the inguinal wound. The incision is made in a direction coinciding with the natural lines of the skin, in accordance with Kocher's principle of normal incisions. It is therefore a transverse incision the mesial end of which is somewhat lower than the lateral end. As far as the attachment of the testicle is concerned, it would make no difference in what direction the incision runs, but for the

FIG. 16.—A case of bilateral ectopy operated at the age of twelve, five years after operation.

FIG. 17.—A case of bilateral ectopy operated at the age of twenty-two, twelve years after operation.

FIG. 18.—A case of bilateral ectopy operated at the age of twelve, seventeen years after operation.

stretching and development of the scrotum the transverse incision affords a much safer and more equally balanced attachment than would be the case in a longitudinal incision. It should be of sufficient length to accommodate the long diameter of the testicle. The incision is deepened until the fascia of the thigh is exposed. (Fig. 4.)

A pocket is now made by gently digging with one or two fingers from the lower end of the inguinal incision through the loose connective tissue to the bottom of the scrotum. Here the pocket is opened by an incision which corresponds in length and direction precisely with that in the thigh, in order that the cut edges may be united evenly, without any misfits. (Fig. 5.) As the channel thus established is bound to collapse when the fingers have been removed, a strip of gauze or a tape is drawn through it, so as to avoid the necessity of digging the channel anew after one lip of the scrotal wound has been sutured to the corresponding edge of the wound in the thigh, as that manipulation might impair the perfect alignment we have striven to attain in applying the suture. (Fig. 6.)

The next step is that of uniting the upper edge of the thigh wound with the corresponding edge of the scrotal wound. When these two edges are approximated in order to be sutured, the operator finds the raw surface of each of the two flaps turned toward him, the skin side away from him, exactly the opposite of the relations met in the ordinary skin suture. If now the usual procedure for inserting the sutures were followed, namely from surface to depth on the first edge and from depth to surface on the second edge, the knot of the suture would lie on the raw surface. As it is preferable, however, to place the knot on the skin surface, the routine of suturing is reversed, namely from depth to surface at the first edge and from surface to depth at the second edge. (Fig. 7 and insert.) Interrupted stitches are used, as they make a better adaptation than a continuous suture. Safe healing of this suture line requires a sufficient amount of raw surface of each flap to be adapted. To accomplish this the relation of the points of entry and exit for the needle should be such that on the skin side the stitch hole is much closer to the edge than on the raw side, thereby preventing the skin from turning in, which the skin of the scrotum is particularly prone to do. On the scrotal side, therefore, this rule is more imperative than on the side of the thigh. Were the skin permitted to roll in, there would, of course, be no union wherever it is inverted. It is of importance to observe these little details in inserting the stitches, for, after they are placed, it is impossible to correct a faulty adaptation of the edges; the sutures must be applied properly from the start. Fig. 8 represents this step of the operation completed. The entire posterior lip of the scrotal wound has been united with the corresponding edge of the thigh wound. The skin surface, on which the knots lie, is concealed. From this illustration it is at once apparent that the sutures are no longer accessible without much trouble and could not be easily removed,

except perhaps the two end sutures. Therefore catgut is employed for this row of sutures.

The next step is that of fastening the testicle to the fascia of the thigh. The testicle, which is lying in the inguinal wound, is now to be brought down through the channel that was dug between the inguinal and the scrotal incision and which has been prevented from getting lost by the introduction of a strip of gauze or a tape. A curved clamp is made to grasp the tape at the scrotal end and with its guidance is drawn up till the tip of its jaw appears in the inguinal wound. The tunica of the testicle is grasped (Fig. 9), and the organ is drawn down so as to emerge from the scrotal wound. Two sutures of fine chromicized catgut are carried through the tunica albuginea testis and the fascia of the thigh, with care not to injure the femoral or saphenous vein. Both sutures are inserted before either of them is tied, as the tying of one may render the insertion of the other difficult. (Fig. 10.) Probably one suture would suffice.

The attachment of the testicle to the fascia having been finished, the anterior lip of the scrotal wound is sutured to the lower edge of the thigh wound. Fine silk is employed, and on inserting the stitches the tendency of the scrotal skin to turn in should again be remembered and counteracted. (Fig. 11.)

Now the inguinal wound is closed, the first layer being the attachment of the internal oblique and transversus muscles to Poupart's Ligament. (Fig. 11.) This layer covers the cord, as in Ferguson's method of hernioplasty which, although it is not the best method for the hernia, allows the cord to descend in the most direct way, unhampered by any possible kink due to its displacement. Should the nature of a coëxisting hernia, however, make it appear desirable that the cord be displaced either according to my method of hernioplasty or any other method, this step should be taken after the dissection of the cord has been completed and before the testicle is brought down to its new location. The aponeurosis is next sutured and finally the skin.

The operation is now completed. (Fig. 12.) With the aid of a dressing forceps a small strip of gauze is drawn carefully through the canal of skin between scrotum and thigh. It serves as a dressing for the deep skin suture. More gauze, covering scrotum and abdominal wound, completes the dressing. The removal of the sutures is done according to general principles, but it should be remembered that frequently the skin of the scrotum has been attached to the skin of the thigh with some degree of tension, so that enough time should be allowed to assure firm union. The hidden, inaccessible sutures, for which catgut was used, require no attention. The length of time in bed will be determined by a coëxisting hernia, if any; in the absence of a hernia, the patient may get up as soon as a firm union between scrotum and thigh has been established.

The testicle may be released when the scrotum has stretched out to near the normal size. Two or three months will usually suffice, but there is no need of hurry, as the attachment of the testicle causes the patient no dis-

comfort, no drag, no awkward gait, no tendency to eczema, as one reporter seems to have feared. Some adults who were too busy for the operation of releasing the testicle have left it attached over two years in perfect comfort. The earliest release among my cases happened in a patient concerning whom I learnt only after the operation that he was a bleeder. A large exudate formed under the skin of the scrotum, which, after some days' watching, was removed by reopening the skin incision. The wound then healed without any trouble. The hematoma had helped to develop the scrotum so well that the testicle was released five weeks after the operation.

The detachment of the testicle is performed according to usual surgical methods and scarcely calls for any directions. But, as one surgeon told me that his knife made a slight cut into the testicle at this stage, a reminder may be appropriate that the incision through the scar should go no deeper than the thickness of the tissues that had been united at the previous operation, that is, through skin and superficial fascia. The flaps are then lifted, the scrotal flap only to a slight extent, and the testicle is laid bare mostly by blunt dissection, with all due gentleness. The division of the posterior part of the scar will usually have to be deferred until the underlying tissues have been separated from it. The testicle is then buried in the scrotum, and both wounds are closed by sutures.

In bilateral retention only one testicle is brought down at a time, as the rudimentary scrotum could not be fastened to both thighs without great danger that an inadvertent motion of the thighs would tear loose the sutures. The second testicle is brought down at the same time that the first one is detached from its thigh. (Fig. 13.) Figs. 14 and 15 show a bilateral case previous to the third stage. Before the first operation his rudimentary scrotum was indicated by the presence of some wrinkled skin close up against the perineum. At the first operation the right testicle was brought down; six months later the right was released and the left brought down. Since that time another six months have elapsed and the left side has also developed perfectly. Figs. 16, 17 and 18 show the final results in three patients, each of them a case of bilateral non-descent, five years, twelve years and seventeen years respectively after operation.

Dr. H. W. Meyer, in an interesting article on "Undescended Testicle," in which he illuminates the subject from many aspects, cites the follow-up results of all the cases operated according to my method at the Lenox Hill Hospital from 1906 to 1926. He states that there were sixty-four cases, every one of which was a perfect success, the testicle being placed well at the bottom of the scrotum. Of those cases forty-eight had been operated upon by me. This number does not include the private patients on whom I operated at the same hospital nor any cases operated by me at other hospitals. And I may add that all those other cases as well as those operated subsequent to Meyer's report have been equally successful.

The operation may be performed at any age—my youngest patient was three, my oldest thirty-eight years of age—but the best time is before puberty,

say between the ages of six and ten. The belief that it is possible for an ectopic testicle to assume its normal place is not an erroneous legend, as has been claimed elsewhere; I have seen it occur in a few cases including one of perineal ectopy. In cases where I operated at a very early age, there was always a special reason for doing so, such as strangulation of an accompanying hernia or recurring pain suggestive of strangulation of the testicle or torsion of the cord. But it would be unwise to postpone operative correction too long, as the normal development of the testicle is more likely to occur if it is brought down some time before puberty.

DIFFUSE ENDOTHELIOMA OF BONE

EWING'S SARCOMA

By Harry Koster, M.D., and Morris Weintrob, M.D.

of Brooklyn, New York

FROM THE SURGICAL CLINIC OF THE CROWN HEIGHTS HOSPITAL

In 1921 Ewing[1] described a variety of bone tumor the structure of which differed markedly from that of osteogenic sarcoma. Nor was it identical with any of the known forms of myeloma.

Previous to this communication, these tumors were classified as "round-cell sarcoma" of an unknown origin and nature. To this newly segregated group Ewing gave the name of "diffuse endothelioma of bone." Kolodny[2] supported Ewing's theory as to the specificity of the group but doubted their origin from perivascular endothelium. Connor,[3] on the other hand, sided with Ewing in the belief that the tumors arose from some type of endothelial cell in the bone marrow, although he, too, questioned their perivascular origin. To him, the cells of the reticulo-endothelial system were the most probable site of origin.

Diffuse endothelioma of the bone presents certain characteristics common to other varieties of bone tumors. Pain and swelling are constant findings. If a lower extremity be the seat of involvement, the patient in most instances will limp. A mild fever, associated at times with a moderate leucocytosis, gives evidence of some degree of systemic disturbance. Over the tender, firm mass found on examination, one will frequently note a dilatation of the superficial veins. Occasionally, even without subjecting the growth to irradiation, regression in size takes place.

This tumor, according to the statistics of Copeland and Geschickter,[4] is fatal in 87 per cent. of cases. This variety of new growth simulates malignancy in general in that it is usually associated with a moderate anæmia, is composed of very cellular tissue, gives rise to pulmonary metastasis, and is characterized by a terminal cachexia.

Certain manifestations, however, are peculiar to diffuse endothelioma of bone. Primarily, although occasional instances of occurrence in middle and later life have been reported, the disease is one of youth and early adult life. Indeed, in the series studied by Copeland and Geschickter 95 per cent. of the cases were in persons under twenty-five years of age. Approximately eleven months elapsed from the beginning of symptoms until a stage was reached when the patient felt constrained by reason of either pain or disfigurement to apply to a physician for relief. A history of trauma was elicited in about 30 to 40 per cent. of instances, this actual (or imaginary) trauma having occurred approximately five months previous to the onset of symptoms.

The onset may be characterized by either tenderness or soreness of the

affected part, pain with formation of a tumor or the occurrence of trauma may call attention accidentally to the presence of a tumor which had produced no symptoms whatsoever. In time the early tenderness gives way to severe pain which is usually continuous. Occasionally, remission with diminution in the size of the tumor occurs. A moderate elevation in temperature and a slight feeling of malaise may accompany the increase in size of the tumor. Locally, there may be redness and swelling of the subcutaneous tissue or dilatation of the peripheral veins.

Local examination usually reveals a swelling varying in size from a small circumscribed mass to a large fusiform tumor, apparently continuous with the sheath of the bone. In most instances the soft parts over the tumor are freely movable. They may, however, be rather œdematous and inflamed and quite hard. The presence of osteophytes in the tumor of the soft tissue may give rise to the sensation of crepitus. The tumor generally involves the shafts of long bones and usually more than half of the shaft, the distribution progressing toward an end of the bone. It produces a widening of the shaft mainly, apparently, by the deposition of endosteal bone causing spreading of the lamellæ. The X-ray examination reveals longitudinal striations which are characteristic. Occasionally, there may be onion-like layers of periosteal bone formation similar to that seen in osteomyelitis. On the whole it is an osteolytic growth rather than osteogenic.

The tibia is the bone most frequently involved. The cortex becomes expanded and thickened. Primarily, there is no destruction nor considerable formation of bone, the tumor diffusing rapidly by infiltration. Destruction is a late manifestation and pathological fracture is rare. Metastasis takes place to membranous and cartilaginous bones, a predilection for the skull being quite noticeable. The regional glands are frequently involved. Hæmoptysis, thoracic pain and fever are usually terminal manifestations.

Although the marrow is often involved, Bence-Jones protein is not present in the urine.

Ewing's sarcoma is most frequently confused with subacute or chronic osteomyelitis. If, in doing a biopsy, the surgeon fails to go deeply enough to reach intact tumor cells, the specimen removed from the peripheral portion of the tumor infiltrated with mononuclear cells and fibrous tissue may prove to be misleading. As an example of characteristics of this disease the following case report is submitted:

CASE.—S. R., male, born in Italy, sixty-two years of age, was admitted March 3, 1930, to the Crown Heights Hospital. His chief complaints on admission were pain in the right arm and shoulder, inability to move the right upper extremity, and loss of weight. His previous medical and surgical history were negative. His wife and eight children were alive and well.

The present history dated back seven months before admission at which time the patient noticed a bulging over the right shoulder. Pain on motion of the right shoulder-joint appeared at about the same period. A slight pain in the upper portion of the right humerus, even when at rest, soon became quite annoying. This was followed by a marked loss of appetite associated with considerable loss of weight.

When admitted to the hospital there was moderate cachexia. Except for sordes and carious teeth the head and neck were normal. The heart was normal save for poor muscular quality There was a slight dulness over the right base of the lungs and a few subcrepitant râles were heard over this area. The abdomen was negative. The genitalia, rectum, glandular system, vertebral column and skin presented nothing abnormal.

The extermities were negative except for the right upper. The head of the humerus was somewhat enlarged. The right arm was held at the side with the elbow flexed at about 90 degrees. Over the infraspinal portion of the right scapula there was a hard mass, about equal in size to a small grapefruit, apparently attached to the scapula. The upper portion of the humerus was rather tender. Attempts to increase or decrease the amount of flexion at the elbow resulted in considerable pain.

The clinical impression was that of osteosarcoma involving both the right humerus and scapula. The erythrocyte count ranged between 3,060,000 and 3,850,000. The hæmoglobin varied between 61 per cent. and 75 per cent. The white cell count showed 10,000 leucocytes. In 100 cells counted there were 49 neutrophiles, 40 lymphocytes, 8 mononuclears and 3 eosinophiles.

Röntgen examination revealed a marked destruction of the bones of the humerus beginning at the anatomical neck and extending downward for a distance of 4 inches. The cortex in this area was expanded and broken through in many places. Some irregular calcific deposits were visible in the soft tissues. The rest of the humerus showed an evenly distributed moth-eaten appearance which involved both the cortex and medulla. There was a pathological fracture through the upper fourth of the humerus. There was an extensive destruction of the greater part of the scapula with perforation of the periosteum in the lower half. Many irregular islands of calcific deposits were visible in the soft tissues for a distance of 3 inches from the axillary border of the scapula. The parts of the scapula in the vicinity of the glenoid fossa showed an extensive moth-eaten appearance similar to that visible in the shaft of the humerus. The articular surface of the scapula and humerus was not involved.

The findings were indicative of a new growth involving the entire scapula and the upper half of the humerus with extension into the adjacent soft tissue. The appearance suggested sarcoma. X-ray examination of the bones of the body and the lungs did not reveal any metastasis.

Operation.—March 8, 1930, under spinal anæsthesia 300 milligrams of neocaine dissolved in 8 cubic centimetres of cerebrospinal fluid, injected between the second and third lumbar vertebræ. After double ligation of the subclavian artery and vein and severance of the brachial plexus an interscapulo-thoracic disarticulation of the right upper limb after the method of Berger was done, including all of the scapula and the outer third of the clavicle.

Post-operative Course.—Two days after operation, the patient presented signs and symptoms of hypostatic congestion of the right base leading to a suspicion that pneumonia was developing. The lung findings and the patient's general condition soon improved. A slight seropurulent, superficial discharge from the wound which cleared up in a few days marred an otherwise excellent healing of the extensive wound. The patient was discharged as cured on the twenty-third day after operation.

Some months later, the patient was admitted to another hospital to receive treatment for hæmaturia, pain in the back and "dirty" urine. Cystoscopic examination revealed clear urine in the bladder. There was a bulbous œdema at the mouth of the right ureteral orifice, the latter being markedly enlarged. Blood and urine were seen to spurt from the right ureter. Urine from the left kidney returned clear. Injected dye was recovered in six minutes. Routine urine examination at first showed a few red blood cells, many epithelial cells and leucocytes. Later specimens did not contain any erythrocytes. X-ray films of the dorsal and lumbar regions of the back showed a

hypertrophic osteoarthritis of the spinal vertebræ. The patient was discharged against advice. He died at home early in December, 1930, after sustaining a traumatic fracture of the femur.

Pathological Report of Specimen.—The specimen consisted of the humerus, scapula and part of the clavicle (Fig. 1). After removal of the soft parts, notably the musculature, two distinct growths were made out. The smaller growth was round, occupied the upper end of the humerus and was fused firmly to the scapula. The humerus proper was fractured right below the tumor and was easily movable, causing crepitation.

The larger tumor was oval in shape and somewhat flattened. It substituted the major portion of the scapula and infiltrated the muscles on both the anterior and posterior surfaces. Both tumors were rather soft. On section, they presented a lobular

FIG. 1.—Gross specimen showing the tumor.

structure. Their color was pale, pinkish gray, irregularly mottled by sulphur-yellow patches. These patches were opaque in contradistinction to the rest of the tumor.

Microscopical Findings.—The tumor consisted of alternating areas of fibrous, acellular and richly cellular tissue (Figs. 2 and 3). The latter revealed scattered foci of necrosis shown by poor staining of the nuclei. In other places karyorrhexis indicated the progress of cell death.

The cellular areas occasionally showed a wealth of small cells with round, darker stained nuclei and some eccentrically arranged basophilic cytoplasm. The characteristic cells of the tumor, however, were much larger. Their nuclei were oval or irregular in shape. The chromatin of these nuclei was rather scanty, showing a discrete, dust-like distribution. The cytoplasm was quite abundant, very clear and took hardly any stain.

The arrangement of the tumor cells was quite characteristic. They showed a tendency to form groups almost like epithelial cells; yet they lined narrow channels resembling capillary vessels. Quite often, there was also a basement membrane which supported the tumor cells. These membranes were often interconnected with fibres of

the reticulum. There were areas in which the tumor tissue seemed to be quite solid, without any formation of channels. These areas were conspicuous for the large size and irregular shape of the tumor cells, some of which appeared in gigantic forms with big nucleoli in a vesicular nucleus.

The architecture of the tumor justifies its classification as an endothelioma of the type described by Ewing as *diffuse endothelioma of bone.*

Although there could be no doubt regarding the presence of a neoplasm, the diagnosis of endothelioma could not be made before operation. The age, the location, the pathological fracture and X-ray appearance were all misleading and only by the aid of the microscopic picture could the tumor be properly classified.

X-ray treatment in such tumors produces a temporary regression of the growth but in no way influences the development of metastasis. Bloodgood[5] believes that diffuse endothelioma of the bone is best treated by amputation with a post-operative course of irradiation if the lower extremity be involved

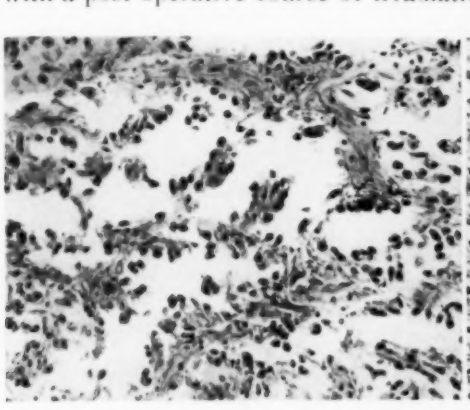


FIG. 2.—Diffuse endothelioma of the bone. Wide sinuses lined with tumor cells.

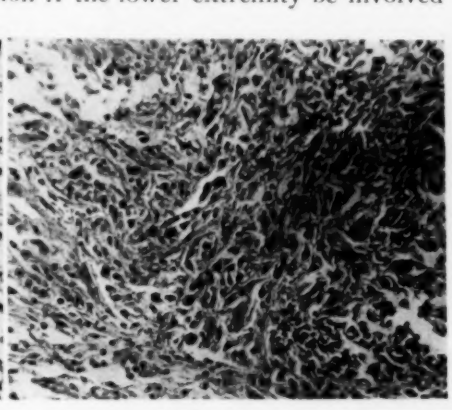


FIG 3.—Solid portion of diffuse endothelioma of the bone.

below the upper third of the femur and no other growths are evident. Resection of the bones should be resorted to in lesions of the upper extremities, provided no metastatic involvement has been discovered. This, of course, holds true for all diffuse and malignant lesions of the bone.

When a case presents itself with involvement of the upper part of the femur or, if in the upper extremity, the growth is so widespread that the operation of choice is not warranted because of the extent of the amputation necessary for complete removal, irradiation must be attempted and continued in therapeutic doses until some such time when the severity of the pain compels resort to the mutilating procedure.

The mortality of interscapulo-thoracic disarticulation in tumor cases is about 4 per cent. Despite this, however, the life of the patient cannot ordinarily be prolonged beyond a year according to Treves[6] who cites a 75 per cent. mortality in that time. Jeanbrau and Riche[7] state that in 105 cases reviewed by them there was an average post-operative length of life of three years. They found twenty-four recoveries of five years' duration

and some of ten to fifteen to sixteen and twenty-six years' duration. These cases were operated upon for malignant neoplasms involving the humerus and scapula but the type of lesion was not accurately described. Then, too, the interpretation of microscopic appearance of these tumors has undergone considerable revision in the past ten years. However, the point is made that malignant disease in a situation such as this is not a totally hopeless matter and the acceptance of the radical operation should be urged.

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TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY AND THE PHILADELPHIA ACADEMY OF SURGERY

JOINT MEETING HELD FEBRUARY 11, 1931

Dr. Edwin Beer, President of the New York Surgical Society, in the Chair

OPERATION FOR LARGE VENTRAL HERNIA

Dr. Charles L. Gibson presented a man forty-six years of age who, following an operation in 1926 for a perforated duodenal ulcer, devolped a huge incisional hernia. This hernia was repaired June 17, 1930. The operation was very tedious as there was much intra-abdominal work also necessary. The wound was closed by suturing by layers the peritoneum and the sheath of the rectus after opening the mesial edges to approximate the muscles; antero-fascial layers of rectus were approximated after parallel releasing incisions of the fascia two inches to the outer side.

There was prompt convalescence. The condition today is absolutely firm. The man weighs 245 pounds. The case is presented to show that even the most extensive hernia can be treated successfully by this method and that there is no necessity for procedures of doubtful value, such as the transplantation of fascia. The seeming, or theoretical weakness of the wall at the site of the releasing incisions has never been realized in practice. This procedure was described in the Annals of Surgery for 1920 in which the only case to have a recurrence, and that only partial, was reported. Since then a large number of such operations have been done with absolutely no failures, although no case has ever been refused, no matter how unpromising. The method has also been applied to umbilical hernia and has proved more satisfactory than the usual fascial overlapping operation.

Dr. George M. Laws said that the principle of the releasing incisions has proven sound and whatever fears surgeons may have had of lateral recurrence have now been dispelled. Intra-abdominal work is not always necessary. There are two kinds of incisional herniæ. One is perhaps not properly called a hernia because it does not have a true peritoneal sac. It starts as a protrusion into the wound and acquires a false sac by condensation of areolar tissue. It may burrow extensively, is prone to cause trouble and requires intra-abdominal operation. In the other kind, with a true sac, one may sometimes reduce the unopened sac *en bloc*, as it were, bring over a layer from the margins of the hernial defect and then proceed with the repair of the fascia. This lessens the time consumed and the danger of complications.

Dr. George P. Muller said that he had had a number of these cases of ventral hernia both above and below the umbilicus. His method differs from that shown by Doctor Gibson in that after making the incision in the fascia and suturing the median edges together it was often possible to bring the lateral edges together in the median line, thus covering the rectus muscle with fascia. This would prevent the possible bulging that might occur from having no fascia support over the rectus muscle.

IRRADIATION OF PRIMARY OPERABLE CARCINOMA OF BREAST

Dr. Burton J. Lee presented cases of primary operable carcinomas of the breast to illustrate a method of treating these patients by measured tissue doses of irradiation. Until about one year ago the routine procedure in primary operable carcinomas of the breast at the Memorial Hospital was to give a high-voltage cycle over the breast and drainage area as a pre-operative measure. Approximately three weeks after receiving this pre-operative irradiation the patient received radical amputation. When the wound was well healed and the patient in good general condition—which was usually the case in about four weeks after operation—a similar post-operative X-ray cycle was given. When the tumors in these patients were carefully studied grossly and histologically after amputation it was found by Doctor Ewing, in the pathological laboratory, that the cellular degeneration in the tumors was only of a slight degree and that the tissue changes in the environment of the tumors were not of marked degree. Although the use of pre-operative X-ray gives a certain degree of tumor sterilization and change in its environment which is favorable to the ultimate end-result, it was felt that some means of more effective irradiation should be applied in these patients if complete tumor devitalization was to be accomplished.

Therefore, during the past year the primary operable cases to be subjected to radical amputation have received a measured tissue dosage of pre-operative X-ray combined with interstitial radium, by means of the introduction of gold radon seeds or gold radon wires. With the help of the physical laboratory it has been possible to translate the dosage received by the tumor into treatments of skin erythema unit dosages which would have been delivered had the high voltage X-ray alone been employed. Studies in the pathologic laboratory have revealed that complete devitalization of cancer of the breast can be accomplished in the average case by the administration of the equivalent of ten to twelve skin-erythema units. It is obviously impossible, with our present methods of external irradiation, to administer this dose by any external means. This is the reason for the present method of interstitial irradiation which always follows external irradiation. They had taken account of the possible hazard to the patient of the insertion of these radon seeds by means of needle trocars directly into the tumor. Theoretically, one might feel that tumor tissue at the end of such a needle might be introduced into an open lymph or venous channel. Up to the present time, they had seen no instance of diffuse metastasis following this method and they do not believe it occurs, but sufficient time has not elapsed to thoroughly prove or disprove this point. Under this method complete tumor devitalization has been accomplished. Somewhere over one hundred cases have been treated along the lines outlined. At present all primary operable cases entering the Memorial Hospital are divided into one of three groups without selection.

Group A.—High-voltage X-ray cycle plus interstitial radon using a measured dose of ten to twelve skin-erythema doses, and a comparable amount is given into the axilla. Six weeks after the introduction of the radon a radical amputation is performed. In order that they may be convinced of the efficacy or ineffectiveness of this method, no post-operative radiation is being given in this case, which would complicate their conclusions.

Group B.—Radical amputation is being withheld entirely, reliance being placed upon the use of radiation alone by means of the high-voltage X-ray and interstitial radon—measured dosage being the same as in the cases subjected to radical amputation.

Group C.—Surgery only is employed, furnishing a check group for ultimate end-results.

CASE I.—Widow, aged seventy-five, born in Constantinople. For the last four years she has noticed a small lump just below the areola in the right breast. Apparently it has not increased in size. For the past two months there has been some slight sticking pain in this region and for the past three weeks slight redness overlying the skin. Physical examination showed an elderly woman with a tumor 3.5 by 3 by 2 centimetres just above the right nipple in the mesial portion of the breast. The skin over this is adherent and slightly reddened. No definite adenopathy. She was selected for treatment by irradiation alone and was given 1000 per cent., or a skin-erythema dose, delivered to the tumor, and furnished by means of one high-voltage X-ray and the introduction of 25 millicuries of radon seeds into the tumor, furnishing 3325 millicuries. Following external irradiation at the time gold radon seeds were inserted, biopsy was done. Report from the pathological laboratory was as follows: "Carcinoma infiltrating fat and fibrous tissue. Small cells. Insufficient to classify and grade. Marked radiation vascular changes and calcification." Following irradiation marked redness of the skin developed with slight blistering, but this rapidly healed. Last visit to the clinic December 29, 1930. At that time disease appeared inactive.

CASE II.—A woman, widowed, aged forty-six, American. Four days before admission noticed a lump in the right breast. Since that time she has been conscious of slight sticking pain in the same area. There has been some nipple discharge. Physical examination showed a tumor in the right lower quadrant of the right breast measuring 3½ by 3 centimetres. One soft palpable node in the corresponding axilla which was believed not to be significant. Pre-operative irradiation was given using only interstitial radon; 32.37 millicuries of radon were inserted into this tumor on October 25, 1929, and at the same time 18.9 millicuries in the right axilla, furnishing an equivalent of 1300 per cent. of a skin-erythema dose. November 11, 1929, a right radical mastectomy was performed. The wound healed by primary union although about three weeks had elapsed from the time of administering the interstitial radiation. Examination of the specimen showed "a duct carcinoma of the breast with extensive squamous metaplasia, destruction of tumor and productive fibrosis. No tumor was found in the nodes." Her course since then has been uneventful. Her last visit was in January, 1931. At that time there was no evidence of disease. She is shown as a primary operable carcinoma of the breast, treated pre-operatively by using interstitial radiation 1300 per cent. of a skin-erythema dose into the tumor and followed three weeks later by radical amputation. Now one year and four months since beginning of treatment without evidence of disease.

DISCUSSION: DR. JOHN B. CARNETT said there would always be a certain number of patients for whom surgery was impossible, because of poor operative risk, flat refusal to submit to operation, or advanced disease. Treatment of these cases by X-rays alone has been very disappointing as shown by the frequent tendency to local recurrence whenever treatment was interrupted for a few months, and also by practically always finding cancer cells whenever a later simple amputation was done, either because of persistence of a fibrosed mass or because of irradiation necroses. Surface irradiation alone cannot be depended upon to cure these cases and they should routinely receive interstitial irradiation by either radium element or radon.

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Keynes, at St. Bartholomew's Hospital in London, has been so impressed by the results of small doses of radium buried in the breast and its lymphatic drainage areas for several days at a time that he now prefers interstitial irradiation to operative removal even in early breast cancer. As he points out, however, implantations are attended with some dangers. He knows of cases in which radium needles have damaged the internal mammary and axillary vessels, and have punctured the heart or pleura—in one case the needle dropped to the bottom of the pleural cavity. He has seen skin implantations at the site of needle punctures. In one case of early breast cancer, known to the speaker, preliminary röntgenograms of the chest and bones were negative before radium implantations but the patient died of widespread dissemination three months later. The result might have been the same in the absence of irradiation but the possibility of the implantation needle having opened a vein for the cancer cells to pass into the general circulation cannot be dismissed. Interstitial irradiation, to be effective, has to be pushed to the limit with resulting necrosis in some cases that calls for limited excisions. These various mishaps affect only a very minor percentage of cases and by no means contraindicate the intelligent use of interstitial irradiation in patients not subjected to operation.

In the past few years, Doctor Carnett said he had become more and more impressed with the frequency with which cancer is disseminated widely through the breast. Cheatle has stressed this point. The speaker sends specimens of many of his breast amputations to Wainwright, at Scranton, and from them he prepares large microscopic slides by Cheatle's technic, giving a bird's-eye view of the breast, pectoral muscles and axillary contents. A study of these slides, and the experience of pathologists with whom the subject has been discussed, indicates that cancer is commonly far more widespread in the breast than is generally believed.

Doctor Carnett declared himself to be an ardent advocate of Handley's theory of lymphatic permeation, but in addition to the lesions that may occur in the breast from that process, he believed other distant breast extensions occur from fairly rapid dissemination of cancer cells along the milk ducts. In view of these considerations effective treatment demands that the interstitial irradiation should include the entire breast. Doctor Lee limits the breast irradiation to the section in which the primary lesion is located and judging from some recent motion pictures of Keynes' technic it is doubtful if the latter's method is adequate to irradiate the entire breast. Cheatle's technic aims at inclusion of every part of the breast. Whatever method is used on the breast itself the lymphatic pathways beyond the breast must receive attention. Doctor Lee has given this in his cases. Further experience is needed to determine the best method for implanting needles in the lymphatic areas. Handley has demonstrated the need for inclusion of the region along the internal mammary vessels homolateral to the breast lesion. External irradiation should precede the introduction of needles or hollow wire and the

use of long needles is safer than seeds to devitalize the cancer cells along the needle tract.

Doctor Carnett said he believes that a combination of radical surgery and irradiation is the treatment of choice in early breast cancer but a debt is due to Doctor Lee and other pioneers for their work on interstitial irradiation in the nonoperable group of breast-cancer cases, and it is possible that further experience with it may give in early operable cases better results than surgery.

Dr. Eugene H. Pool asked Doctor Lee to give the figures showing to what extent surgery with and without radiation has been successful in cancer of the breast. He asked this question in view of the fact that Doctor Lee had stated that surgery was not successful. He wished to know how many cases there were in which radiation alone had shown results. Were the ones Doctor Lee cited as successful exceptional? He thought this information would prove of value in estimating how much promise could be expected by this method.

Doctor Lee, in closing the discussion, replied to Doctor Pool that surgery in carcinoma of the breast in many groups gave 35 per cent. five-year results without evidence of recurrence of the disease. The best that could be offered with this method at the Memorial Hospital of high-voltage X-ray and postoperative irradiation was 39 per cent. The difference between 35 per cent. and 39 per cent. is inconsiderable, but it leads to the feeling that the high-voltage cycle is of some value. As for the irradiation results, there are a number, in a series of cases that have gone five years, who have had palliative removal of the breast, so it would be impossible to separate the figures in those cases. In the group treated by irradiation alone, 31 per cent. have gone five years without evidence of disease.

TREATMENT OF UNDESCENDED TESTICLE

Dr. Franz Torek read a paper with his title, for which see p. 97. The reading of the paper was accompanied with the presentation of patients and of lantern slides.

Dr. Hubley R. Owen stated that the question of undescended testicle resolves itself into three main queries: *Why should one operate? When should one operate? How should one operate?*

Many surgeons are of the opinion that bilateral nondescended testicles are aspermatic, but the case shown by Doctor Torek disproves this theory. Spermatozoa are found in testes that fail to reach the scrotum but usually when found the subject has been young and the presence of the spermatozoa is transient.

He agreed with Bland-Sutton who states a testis is retained because it is imperfect. It has also been shown by Wangensteen that the scrotum is not a mere receptacle for the testes but, by its multitudinous sweat glands, by

the maintenance of an equitable temperature for the testes and by the action of the cremasteric muscle, the function of the testes is enhanced. Therefore, the Torek operation offers the best end-results because by this operation we can have a properly constructed scrotum.

One operates, therefore, in order to restore function to an otherwise aspermatic testis.

Should one operate for fear of malignancy of the undescended testis? Statistics vary greatly concerning the question of the malignancy of the testis in this condition. Bland-Sutton states 75 per cent. of testes retained in the abdomen become malignant. All observers are agreed that the misplaced testicle does predispose to malignancy. It has been suggested that the inguinal testis is more liable to trauma. Coley states that, in his opinion, trauma is the cause of 33 per cent. of cases of malignancy of the testis. An abdominal testis should not be removed for fear of its becoming malignant, but, if an inguinal testis cannot be placed in the scrotum, it should be removed for fear of trauma and possible resulting malignancy. One is frequently asked to place an undescended testicle in the scrotum because of the cosmetic effect.

Physical requirements for certain positions, notably the police and fire departments of larger cities, bar an applicant who has an undescended testicle. This rule, which may be too drastic, was adopted because of the more frequent occurrence of malignancy of the undescended testicle and the greater danger of trauma to the inguinal testis.

When should one operate? The operation should be performed before the age of puberty. The testis remains unchanged from birth until about ten years of age, after which it continues to develop until puberty. It is agreed that the age of choice for the operation of orchiopexy should be before the age of puberty, preferably between the age of from five to twelve. If a child has a large hernia associated with an undescended testicle it may be preferable to operate earlier than five years of age.

How should one operate? Doctor Owen stated he had not personally operated by the Torek method. He termed the operation the Torek method because of the fact that the Keetley technic suggested that the testes be fastened to the fascia of the thigh by sutures through the gubernaculum. This was for the purpose of traction, whereas Torek sutured the testis to the fascia of the thigh without traction. Any operation requiring traction usually terminates unsatisfactorily.

He had employed the technic of Bevan and found that it was unnecessary, excepting in a very small percentage of cases, to cut the spermatic vessels. This point has been recently emphasized by Bevan. Usually, it suffices to cut fascial bands about and around the spermatic vessels and the vas, and by these measures the testis can be placed in the scrotum without traction.

He has used in two cases the method of Ombredanne. The objection to this method is that it places two testes (when the case being operated upon

is unilateral) in one side of the scrotum. To obviate this in one case of unilateral undescended testes, Doctor Owen placed the right (undescended) testis on the left side of the scrotal septum and placed the left testis, although normally descended, to the right of the septum. The objection to the Ombredanne method is, as some have claimed, that the testis may either atrophy or become gangrenous.

Dr. William B. Coley said that at the Hospital for Ruptured and Crippled, where a very large number of operations for undescended testis have been performed, the method usually employed has been that advocated by Doctor Bevan, with the exception that the vessels of the cord were rarely removed. This method has given very good results in the majority of cases. The Torek method was not employed by them until recent years; they have finally come to recognize it as preferable to any other method in certain cases. As to the time when the operation for undescended testis should be performed, there still exists a great difference of opinion. Some years ago it was the practice of some surgeons to operate on the individual at the early age of five or six years, but personally, he believed in most cases the operation should be postponed until the age of ten or twelve years, inasmuch as, in not a few instances the testis descends into the scrotum of its own accord; so that if one waits until the patient has reached this age, he may find it unnecessary to operate. Relative to the danger of malignant disease developing in the undescended testis, he believed this was a danger that had been very much overestimated. In the first sixty-four cases of sarcoma of the testis that he reported (Annals of Surgery, July, 1915), twelve had occurred in the undescended testis. He added that when one considers the very large number of cases of undescended testis that exist and the very small number that undergo sarcomatous degeneration, the danger of malignancy developing may be regarded as very slight. He does not believe that the presence of an undescended testis in an adult, when it is causing no trouble and is not associated with a hernia, is sufficient grounds for rejecting an employee in the industrial world.

Doctor Torek in closing the discussion, said that as regarded the question of the time to operate, he believed it should be done before puberty, but it could be done at any age. He has operated on a patient as young as three and on one as old as thirty-eight years of age. In the very young patients there was always a special reason for operating, such as hernia or recurring pains suggestive of strangulation or torsion of the cord. He agreed with Doctor Coley that, if possible, operation should not be done too early; he had seen a number of testicles come down without interference, even in one case of perineal ectopy.

TAYLOR'S HEMILAMINECTOMY FOR EXPLORATION

Dr. Byron Stookey remarked that if an adequate exposure of the spinal cord, its roots and membranes can be accomplished by removal of one-half

of the laminæ, leaving undisturbed the spines, interspinous ligaments, arches and muscular attachments of the opposite side, the advantages are obvious. For the cervical and lumbar regions the rather free mobility of the vertebral column makes it desirable to expose these regions so as to have all of the mobility and not jeopardize the stability of the vertebræ. While it is true that dislocation of the vertebræ following bilateral laminectomy occurs but rarely, a number have been reported. With the advent of high-speed travel this precaution to maintain stability is all the more indicated. It is an axiom of modern surgery to disturb anatomic and physiologic conditions as little as possible, and for this reason, if for no other, hemilaminectomy offers many advantages over bilateral laminectomy since free exposure of the cervical and lumbosacral regions of the spinal cord can be obtained.

Certainly no one today would think of exposing the brain by biting away bone and leaving a needlessly large cranial defect as was done a few years ago instead of making an osteoplastic flap. Likewise, he thought that the same conservative attitude toward laminectomy in the cervical and lumbar regions will be observed and whenever possible hemilaminectomy will be done in place of bilateral laminectomy.

Hemilaminectomy has its limitations as well as its advantages. Whenever a spinal-cord tumor cannot be readily removed by hemilaminectomy the exposure should be converted into a bilateral laminectomy. This can easily be done and may require the removal of only one or two arches of the opposite side, thus doing a bilateral laminectomy immediately overlying the tumor and not needlessly above or below the tumor.

Hemilaminectomy of either the cervical or lumbar regions is indicated in the following conditions:

(1) Lateral and ventrolateral spinal-cord tumors.

(2) Spinal-cord tumors involving the vertebræ with partial destruction of the vertebræ.

The operation has been used in these conditions in the patients whom he was showing to them that afternoon. In each, the spinal cord was adequately exposed and the pathologic process adequately dealt with. The spines, the arches and the muscular attachments of the opposite side have all been retained.

(3) Unilateral dorsal-root section and unilateral chordotomy.

(4) As an exploratory procedure especially in obscure and baffling spinal-cord diseases when visual proof of the actual conditions is desirable.

Hemilaminectomy is not presented to replace completely bilateral laminectomy but it has a definite and valuable position in neurologic surgery. Criticism of this procedure has almost invariably come from those who have not tried the operation. The time has come to replace hypothetical criticism by that gained from actual experience with the procedure.

Dr. Charles H. Frazier said that as to the propriety of substituting a unilateral for a bilateral laminectomy, obviously the only objection to the con-

ventional laminectomy Doctor Taylor has unearthed is that in a few cases he has found signs of subluxation. Whether there was any resulting disability in these cases has not been disclosed. He himself had never resorted to this procedure. He could readily understand how a unilateral laminectomy might be permissible under certain circumstances, notably a unilateral cordotomy or rhizotomy. In principle he would disapprove of it for all tumor explorations, since in advance of actual exposure one cannot be sure that a larger exposure, even in unilateral tumors, may not be desirable or eventually necessary.

In the performance of a laminectomy, he had stressed the advantage of securing almost perfect hæmostasis before the dura is opened. One's aim is not to have a drop of blood soil the subarachnoid space. Blood carries fibrin and fibrin begets connective tissue and connective tissue adhesions. Imperfect control of bleeding and crude sponging will readily cause adhesions of membrane to cord and the establishment of a complete block.

To be sure that hæmorrhage from all sources is under control, the preliminary bone work should be completed before the dura is incised. To convert a unilateral into a conventional laminectomy after the dura is opened, therefore, has its objections.

The second point upon which he wished to comment was this: Can one not prevent subluxations and any disability in the post-laminectomized patient? He believed one may obtain this protection by the observance of two technical maneuvers: first, the meticulous closure of the wound by careful approximation of every muscle layer, the intervertebral aponeurosis and the fascial layers. This implies with the skin six or seven tiers of silk sutures. Secondly, and of greater importance, is the separation of muscles from spinous processes and laminæ by a sharp chisel. With it these processes are denuded of their periosteum. Thus, provision is made for regeneration of the arches and the restoration of the posterior wall of the spinal canal. This restoration of the canal with accurate musculo-aponeurotic approximation offers substantial protection against subsequent subluxation or any disability in the laminectomized patient.

In evidence of bone regeneration, he submitted the following: first, that in secondary laminectomies, he had found a bony layer which replaced the laminæ, and, secondly, the X-ray picture of the laminectomized patient.

That morning he had submitted a film for inspection to Dr. Henry K. Pancoast, the röntgenologist, a film taken a year after a laminectomy, of the upper cervical vertebræ. Doctor Pancoast could not believe that a complete laminectomy had been done as he saw the shadow of the regenerated arch.

Dr. Thomas A. Shallow remarked that one of the outstanding arguments of Doctor Taylor's against the complete laminectomy and in favor of the hemilaminectomy was the entire absence of dislocation of the spinal column following his procedure.

Hemilaminectomy in the cervical and thoracic region is not a difficult matter and he had used it with a great deal of satisfaction but not until he

had a dislocation at the thoracicolumbar junction following a complete laminectomy of the eleventh, twelfth thoracic and first lumbar vertebræ. He had thought before listening to Doctor Taylor's remarks that dislocation of the spine following complete laminectomy was not something to be feared.

It can be stated that the above-mentioned case coincides with all the faults that he expounds against complete laminectomy.

Doctor Stookey, in closing the discussion, said that whether in hemilaminectomy or bilateral laminectomy, the wound was closed in layers. However carefully done, closure of dorsal-neck musculature cannot prevent ventral displacement of the vertebral bodies, from which both arches and spines with their muscular attachments have been removed. Doctor Frazier's reference to regeneration of the arches after bilateral laminectomy prompted Doctor Stookey to wonder in what percentage of cases in Doctor Frazier's series this had occurred. Regarding blood within the subarachnoid space, this can be as carefully avoided by hemilaminectomy as by bilateral laminectomy. Doctor Stookey regretted that Doctor Frazier had not had occasion to give hemilaminectomy a trial, being sure that he would find additional uses for this procedure. At almost each discussion of hemilaminectomy someone has presented from personal experience another instance of dislocation following bilateral laminectomy. He called attention to Doctor Shallow's remarks concerning a forward dislocation of a lumbar vertebra with instant paraplegia following bilateral laminectomy.

HÆMATOLOGIC STUDIES AS A BASIS FOR DETERMINING THE SURGICAL RISK IN JAUNDICED PATIENTS

Dr. Richard Lewisohn read a paper with the above title for which see page 80. For remarks in discussion by Dr. I. S. Ravdin see page 86.

TREATMENT OF EMPYEMA AND LUNG ABSCESS BY PACKING

Dr. John F. Connors (New York) read a paper with the above title, for which see page 38.

Discussion by Drs. John B. Flick and George D. Stewart. See pages 53, 54.

STUDY OF CASES OF CARCINOMA OF THE STOMACH TREATED AT THE PRESBYTERIAN HOSPITAL OF NEW YORK, 1916-1930

Dr. Fordyce B. St. John (New York) said that from January, 1916, to December 31, 1930, there were 365 cases admitted to the Presbyterian Hospital of New York with a diagnosis of carcinoma of the stomach. Of these, 120, or 32.9 per cent., received no surgical therapy and would therefore not be considered. Resection was carried out in sixty cases, or 16.4 per cent., of all the cases admitted. Palliative gastroenterostomy was performed in seventy-five cases, a simple exploratory celiotomy was done in eighty-five cases, and in the remaining twenty-five cases some emergency procedure such as jejunostomy or gastrostomy was done.

Of the cases in which only a palliative operation or a simple exploration

was carried out, all died within three years of the time of operation. This excludes four cases that have had a celiotomy done in the past year and are still being followed.

Of the sixty cases in whom resection was considered feasible, twenty-two died post-operative, a mortality of 36.6 per cent. This leaves thirty-eight cases to be followed. There were twelve cases alive and well at various post-operative periods. Eight of the thirty-eight cases, or 21 per cent., have been followed for more than five years. It is of interest to note that six of these eight cases have been followed for more than eight years.

Summary.—(1) Of 365 cases, only sixty were operable. (2) Of thirty-eight cases surviving operation, eight, or 21 per cent., are alive and well after a five-year period.

Three of these cases were presented: (1) Woman, G. C., Billroth No. II and partial colectomy, nine years and nine months ago. (Lambert.) (2) Man, (G. C., Moynihan. Nine years and eleven months ago. (Whipple.) (3) Man, L. C., Billroth No. II. Eleven years and seven months ago. (Lambert.)

(1) It is significant in this series that in but 16 per cent. of all cases applying for relief at the clinic, or one in six, was it possible to remove the growth because of the extent of the lesion at the time of admission.

(2) Twenty-one per cent. of all cases surviving radical operation were alive and well after the five-year period.

(3) In two of the three cases alive and well at about ten years, a visible, palpable mass was noted before operation.

(4) The importance of follow-up information is demonstrated by the investigation of the cause of death in a patient followed nine and a half years, who died of hypernephroma of the right kidney with metastases.

Dr. John B. Gibbon (Philadelphia) said that in order to discuss this question properly one should be armed with statistics made up in the same manner as Doctor St. John made his and he was not so prepared. He was willing to admit that the results of the treatment of carcinoma of the stomach in Philadelphia are no better than these, and, indeed, he hoped they were no worse. One advantage of such studies of results such as this is that one is enabled better to prognosticate in certain cases so as to enable one to select a certain type of treatment. There is one unfortunate thing about carcinoma of the stomach and that is that it is the most insidious form of cancer in any part of the body except the colon, but it becomes so much more rapidly inoperable than carcinoma of the colon that it is much more to be dreaded. The speaker was one of those who believe that carcinoma developing on ulcer is comparatively rare compared with carcinoma that starts as carcinoma. Another observation was that the cases that gave good results from resection were the cases that had developed on ulcer; the case with the long history, not the short history. The speaker had one case alive and well fifteen years after resection, but it was a common experience to have these isolated cases

of long-standing cure. What was needed was to find some way to operate on cases of carcinoma with a short history and this still presented difficulties. Another interesting point brought out by Doctor St. John's figures was the high immediate mortality following resection; it is very much higher than in resection for ulcer.

BILATERAL PHRENICECTOMY FOR PERSISTENT HICCOUGH

Dr. Otto C. Pickhardt presented a woman, thirty-three years of age, who was admitted to the Lenox Hill Hospital July 12, 1930, on account of various gastric disturbances and especially of a hiccough which, with various periods of remission, had persisted for five years. At the time of her admission, she had been suffering from the condition for two months. She had enjoyed good health until twelve years before at which time, after a forceps delivery, various pelvic conditions supervened which culminated in a panhysterectomy done in 1925. Since that time she had never been well, having suffered from a combination of infected conditions of the pelvis. The first attack of hiccoughs occurred during the convalescence from the hysterectomy in 1925 since which date attacks have recurred of varying periods of duration. In 1928, following a cystoscopy, she had an attack lasting ten days; in 1929, two attacks, one eighteen days and one twenty-eight days. For the past six months, there have been many attacks lasting for an hour or more. The present attack, which has determined her present hospitalization, began two months before admission and has continued, excepting for occasional intervals of one day, without relief, except when the patient has slept. The attacks are characterized first, by nausea, then vomiting, then gastric distension and then hiccoughs with expulsion of large amounts of gas. The woman has been subjected to a great variety of treatments by various specialists, hospitals and clinics. The treatments tried have included:

(1) Spinal tap in the Bayonne Hospital which stopped the hiccough for several hours.

(2) Gas anæsthesia which caused convulsions at the time and afterwards.

(3) Hypos of atropine and morphine which sometimes made the patient vomit.

(4) Daily colonic irrigations—no relief.

(5) Cystoscopy—the patient "stopped breathing for twenty minutes."

(6) Chloroform anæsthesia; hiccough stopped only while the patient was anæsthetized.

(7) The threat to cut the phrenic nerve made the patient sign a release, and on her return home the hiccough stopped.

(8) Ice bags to the throat, chest and abdomen had no effect.

(9) Pure oxygen breathing had no effect.

(10) Many medications by mouth, none of which were effective for more than a few minutes.

The patient was a well developed, moderately nourished, white woman who was hiccoughing at ten-second intervals. Physical examination was essentially negative; weight, one hundred and one pounds. By the fluoroscope, while hiccoughing, both sides of the diaphragm could be seen to move in a jerky manner with normal excursion.

On July 18, at 3 P.M., 5 cubic centimetres of ½ per cent. novocaine solution were injected into and toward the right phrenic nerve region. The hiccoughing immediately ceased and the patient went into sound sleep; was quiet until the next day at 1 P.M., when the hiccoughing returned.

On July 19, at 2:30 P.M., 4 cubic centimetres of 1 per cent. novocaine solution were injected into and toward the left phrenic nerve region. The patient went into immediate collapse from which she was revived with difficulty two hours later. From this time, until August 6, in spite of all attempts at medical therapy, the hiccoughs continued. Her physical condition became worse, with continued loss of weight. Various procedures were attended by only temporary relief. Finally, bilateral avulsion of the phrenic nerves in one stage was advised, and performed August 7, 1930, under novocaine.

The right phrenic nerve was first avulsed by winding around a clamp until ten centimetres had been pulled out. During this procedure pain in right shoulder and lower chest complained of, but the hiccoughs ceased immediately. An identical procedure was carried out on the left side immediately after. During this procedure patient again experienced pain during the tearing of the nerve, of which 9.5 centimetres were pulled out. A considerable drop in pulse rate, from 136 to 66, occurred, and there was a drop in respiration from 20 to 16. A barely perceptible cyanosis was present but absolutely no dyspnœa or difficulty in breathing.

The post-operative condition was excellent. No respiratory embarrassment. Respirations costal and deep and rate 24. Pulse 96. Respirations and pulse throughout the night following operation remained a little above normal. Lips and fingers show no cyanosis. The wound healed by primary union, without respiratory or cardiac embarrassment. At the end of a week the patient covered her head with bed sheets and made attempts to hiccough. These attempts were successful and she had steady hiccoughs for two periods of ten and three minutes' duration, with a short interval between. These attacks were similar to those prior to the exeresis of the phrenic nerves.

August 19, she was discharged. Vital capacity cannot be measured through blow bottles as patient states that she does not possess strength enough to raise the column of water in the tubes. Still complains of abdominal gas pains in spite of two to three bowel movements daily. No further hiccough attacks. Röntgenogram shows diaphragm at a slightly higher level than pre-operatively and the excursion markedly less. General condition improving daily.

Follow-up Notes: October 19, her general condition was excellent; she had gained fifteen pounds in weight; no more hiccoughs; occasional spasmodic pain in abdomen.

Röntgenogram and fluoroscopy.—The diaphragm at the same height as in previous examinations, with the right side a trifle higher than the left. On ordinary breathing there is barely perceptible moving of either side of the diaphragm. On deep breathing there is a total excursion of less than one-half inch.

February 6, 1931.—Does not feel as well now as a month ago. Slight loss of weight. Same abdominal pressure and gas. Occasional hiccoughing spell lasting from one to ten minutes, characterized by her as of the "silent variety." Thinks she has it because of belching of gas. Bowels continue to move very well.

Physical examination is negative. Litten's phrenic or diaphragmatic shadow is absent. Weight, 108 pounds.

Röntgenograms.—Stomach of so-called "cascade type." Large collection of gas in cardiac end of stomach and also in the splenic flexure region. No organic disease. Stomach empty at six-hour examination.

Chest.—The patient is carefully examined under the fluoroscope. The diaphragmatic excursion, normal and equal on both sides. When the patient coughed or laughed, excursion was maximum and covered practically two

interspaces between the height of inspiration and expiration. On deep breathing there was a distance of one interspace as an average. The costophrenic angles are clear and the diaphragmatic dome is normal in appearance. The findings contrast sharply with the examination following the operative procedure, when the diaphragmatic excursion was a small fraction of the present finding.

Doctor Pickhardt said that he presented this patient to show that: (1) Plentiful and sufficient respiration can be carried on with at least more than partial paralysis of both diaphragms, artificially produced simultaneously. (2) Forced hiccoughing of minor character and short duration can occur under these conditions. (3) To illustrate early and late changes in the position and excursions of the diaphragm. (4) This operation is feasible in nontoxic cases.

Dr. George P. Muller (Philadelphia) said that he had never performed a bilateral phrenicectomy, by which he meant an exeresis of the nerve, and had not had a case of such long-continued hiccough as the one reported by Doctor Pickhardt.

He had, however, had occasion to practice bilateral interruption at one stage of the phrenic impulse by freezing on five occasions, and, while the singultus was cured, the diaphragm continued to move as seen by the fluoroscope shortly after operation, showing evidence of the transmission of motor impulses below the level of freezing by way of the accessory derivation. In two of these patients hiccough was the reason for the operation and in both, cure was obtained which was lasting for at least six months in one patient, at which time he was not followed further and for two years in the other, at which time he died of cerebral apoplexy. The other three patients were operated upon for that curious condition of tachypnœa, or diaphragmatic tic following encephalitis.

The first case was reported in 1925 by Gamble, Pepper and Muller, himself, and for a period of at least five years, the end of the observation, the patient had remained well.

The second case occurred in a young girl in whom the post-encephalitic manifestations were pronounced. She was relieved by the phrenic nerve freezing and has continued free from diaphragmatic spasm although still suffering from cerebral manifestations of her encephalitis.

The third case was one of mild encephalitis who developed tachypnœa and was temporarily relieved by drinking water. Gradually the water-drinking increased until the time when first seen by the speaker he was taking from thirteen to fifteen quarts of water daily. The phrenic nerves were frozen and after that the patient was unable to develop hyperpnœa although the polydipsia persisted, and it was necessary to put him on an allowance of about 4000 cubic centimetres in the day. He was much improved a number of months later, at which time he was lost from observation.

In 1922, Neuhofer reported the case of a boy eight years old on whom bilateral phrenicectomy had been performed and three years later the diaphragm was still found to be practically immobile. The boy had developed normally,

the thoracic respiration answering all purpose. This case has been quoted and comments have been made that the hypoventilation induced by bilateral phrenic exeresis should so diminish vital capacity as to impair the health of the individual, but in the case reported by Neuhofer, and in this one reported by Pickhardt, the health of the patient seems unimpaired.

Dr. Richard Overholt, working in the laboratory of surgical research of the University of Pennsylvania, has found that in those dogs which recover from bilateral phrenicectomy, the health of the animal seems unimpaired, but he did notice a high instance of post-operative pneumonia in his dogs. He also noted that after the phrenicectomy the diaphragm assumes the position of the normal expiratory phase and that subsequently, perhaps after three months, the diaphragm has retreated so that it occupies a position nearly in the normal relation for that dog.

The observations of a few patients who have died after previous phrenicectomy for tuberculosis of the lung, has shown a complete atrophy of the musculature of the diaphragm. Overholt believes that the lower portion of the diaphragm is due to a replacement of the muscle with fibrous tissue. It lowers the diaphragm for the time being but it may be followed after a time by more complete atrophy and possibly eventration, as shown in the literature. It may be that in this case of Doctor Pickhardt's, a year's observation will show a different condition of the diaphragm.

In reference to the neurotic tendencies of Doctor Pickhardt's patient it is interesting to recall a case in the literature reported by Kappis, in 1924, in which exeresis of the nerves gave no relief. Because the hiccough ceased temporarily after paravertebral injections of procaine, Kappis extirpated the whole left fourth cervical root and the lower and middle left sympathetic ganglion. In spite of this the hiccough returned and he believed that its origin was psychic. Accordingly, the thyroid cartilage was forcibly grasped and compressed and the condition was cured.

PLASTICS FOR BONE CAVITIES

Dr. H. H. M. Lyle presented cases illustrating three different methods of employing soft parts in the plastic closure of large bone cavities. These procedures, though limited in application, are of real value in hastening healing. The cases have remained well ten, eleven, and three years respectively.

The first case represents a primary closure of a bone cavity by pedicle muscle graft; the next is a secondary closure of an osteomyelitic cavity by a muscle pedicle flap with an attached skin button; the third is a secondary closure of an osteomyelitic cavity by Ollier-Thiersch skin grafts applied by means of a stent.

The first patient was one of a giant-cell sarcoma of the external condyle of the femur. The patient, with the X-rays and microscopic slides of the biopsy, was shown before the Society of Clinical Surgery at St. Luke's Hospital, April, 1921. The microscopic examination was: "Sections of soft parts show that they are composed almost exclusively of a dense fibrous stroma in which many fairly regular giant-cells of the epulis type are thickly distributed. The nuclei of these cells are comparatively regular and their morphology is that of one of the more benign types of malignant sarcoma.

The stroma, though very cellular, is composed of nuclei also fairly regular but mitoses are not infrequent. It cannot be considered a benign tumor although it probably has arisen in the myeloid cavity. The older portions of the stroma are less cellular, there is no cartilage, but very early osteoid areas may be found."

At the suggestion of one of the members, a vote was taken on the operative procedure to be followed. Eight members favored a high thigh amputation, thirteen curetting and implantation of radium, four resection of the knee, and one advised that nothing be done. A simple curettage of the bone and surrounding soft parts was done, and a cavity about the size of the fist was the result; this was immediately closed by means of a pedicle

FIG. 1.—X-ray of femur ten years after.

FIG. 6.—Condition of cavity at the present moment.

muscle graft taken from the vastus externus. November 19, 1930, the patient, with his present X-rays, was again shown before the Society of Clinical Surgery at a St. Luke's meeting. He has a perfect functional result. Note in the recent X-rays that although the bone cavity has been materially reduced in size it has not been entirely filled with bone but is in all probability filled with fibrous tissue. (See Fig. 1.)

The second patient had a large osteomyelitic cavity of the head of the right tibia which was closed by a pedicle muscle graft with attached skin button. The history of this patient was: While leading his squad against a machine-gun nest in the Argonne, October 1, 1918, he was wounded by a bullet which passed through the femur and knee-joint, and came out through the head of the tibia. He made the usual round of military hospitals and

on November 2, 1920, was admitted to Doctor Lyle's service at St. Luke's Hospital. He then had a discharging sinus situated on the inner side of the right tibia. The probe passed upward and inward for two and one-half inches. X-ray examination revealed a bony ankylosis of knee. An opaque injection was found to travel through the central portion of the ankylosed area between the tibia and femur.

November 8, 1920, the sinus was excised and the bony cavity thoroughly curetted and the Carrel treatment begun. The cavity was sterilized in twenty-four days.

December 3, 1920, a fat graft taken from the abdominal wall was inserted into the bony cavity and the skin closed over it. This failed and the graft was gradually extruded in the form of oil.

November 12, 1921, the cavity was again curetted and sterilized by the Carrel method. Seventeen days later, the cavity having been rendered sterile, an attached skin-muscle flap was inserted into the cavity and the

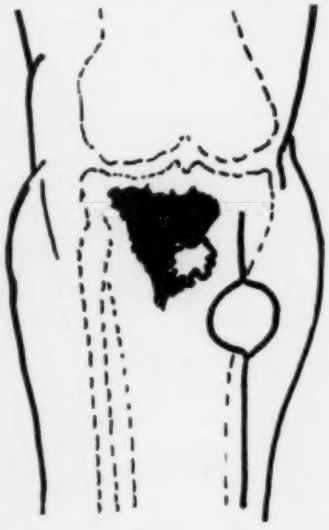

FIG. 2.—Illustrating the technic of closure of pedicle muscle flap with attached skin button (first step).

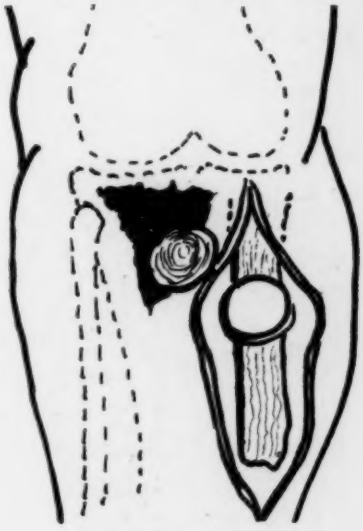

FIG. 3.—Illustrating the technic of closure of pedicle muscle flap with attached skin button (second step).

skin button sutured to the mouth of the cavity. The graft took kindly and the wound healed rapidly.

The following technic was employed (see Figs. 2, 3, 4 and 5): An incision five inches long was made parallel to the internal border of the tibia; the incision started on a level one inch above the sinus and two and one-half inches posterior. At a convenient portion of this incision a button of skin the size of the opening of the sinus was left attached to the muscle, with a flap of muscle tissue sufficient in bulk to fill the cavity, was dissected up, the pedicle being above and posterior to the opening of the cavity. The skin between the cavity and internal border of the tibia was undermined and the muscle flap with the attached skin button was pushed under it into the cavity. The skin button was then sutured to the edges of the sinus and the wound closed without drainage. The present condition of the tibia is seen in Fig. 6.

The third case is that of a patient who fell from a high bridge fracturing his femurs, humerus and right tibia. He came to the hospital for closure

of an osteomyelitic cavity of the right tibia. After seven and one-half months, the wound, despite good surgical treatment, is represented by a granulating trough-like wound 4½ by 1¾ by 1½ inches. The wound was first sterilized by the Carrel method and a stent of dental wax molded to fit the cavity. The stent was wrapped with the skin grafts in such a manner that the epithelial surface was against the stent and the whole placed in the cavity. Eight days later the stent was removed, and 80 per cent. of the cavity was found to be covered by a healthy epithelium. In twenty-seven days the surface of the cavity was completely epithelialized. The cavity is greatly diminished in size.

Doctor Lyle has found these three simple procedures valuable in solving some of the problems of reconstructive work.

Dr. B. Franklin Buzby said that his own experience with the transplant of muscle in these cases had been rather bad; every patient has had considerable post-operative pain. He was sure he had put in muscle and fascia alone without any sensory nerve. In the small cavities one can use bone fragments

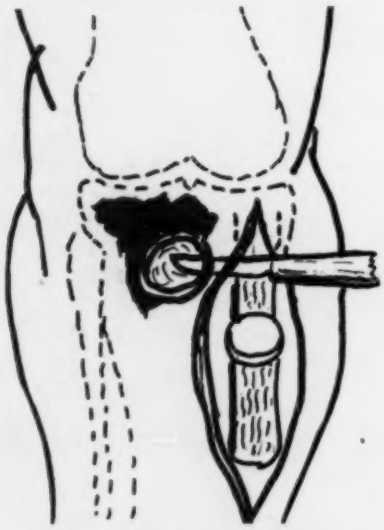

Fig. 4.—Illustrating the technic of closure of pedicle muscle flap with attached skin button (third step).

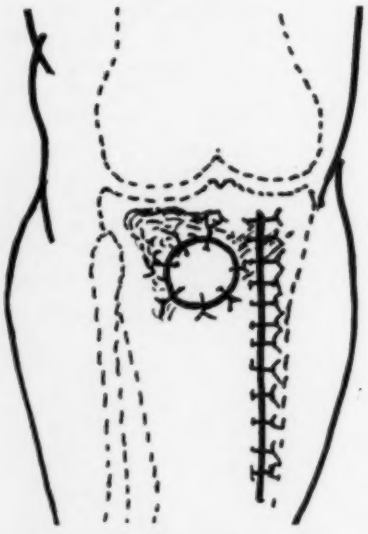

Fig. 5.—Illustrating the technic of closure of pedicle muscle flap with attached skin button (final step).

obtained nearby with rapid subsequent recalcification in the cavity. The type of cavity to be filled in decides the type of graft. In the compound fracture case he believed a long way around was taken to secure the same result that could have been obtained by using the Orr technic in the beginning. Ordinarily, cases of tibial osteomyelitis heal in six months or less with satisfactory skin and with the bone level almost up to where it was before operation. In the bones entirely surrounded by muscle the same procedure is adaptable as well, as the bones will fill out to the proper size if sufficient time elapses and secure packing is kept in place. The speaker had a patient from whom he removed an area in the tibia six inches long and in less than six months the tibia was filled out to where it was before operation. In the femur and the

humerus it is unnecessary to use the graft treatment because they also can be packed snugly. In cases where the bone lesion has healed it is ill-advised to do plastics on cavities for when the skin and periosteum are separated from the bone, frequently the skin will become necrotic and a large area will become gangrenous due to lost blood supply. Filling these bone cavities with inorganic or organic salts of lime is still in the experimental stage but from reports one can feel hopeful of future results.

FILARIAL LYMPHATIC VARIX OF THE BREAST

Dr. William F. MacFee (New York) in presenting a patient, remarked that since it was established by Lewis[1] in 1872 that filariæ inhabit the blood-stream of man, there has been an active interest in that parasite and in the group of diseases which come under the head of filariasis. Interest was further stimulated by the finding, made by Bancroft and recorded by Cobbold,[2] of an adult female worm in a suppurating lymphatic varix of the arm. Manson's[3] discovery that the mosquito is intermediate host of the filarial organism gave additional impetus to the study of the disease. A part of this interest, no doubt, has been due to the spectacular appearance of the organism itself and to that of its various manifestations. Attention has furthermore been necessitated by the astounding prevalence of infection in the regions to which it is endemic. These regions embrace practically the whole of the area lying between the Tropic of Cancer and the Tropic of Capricorn and extend around the world.

Lying without that zone, the United States up to 1898 had little cause to be interested in filarial diseases. Our acquisition of tropical territories, however, during the latter part of the last century gave us reason to acquaint ourselves with the diseases found in those regions. Guiteras,[4] Mastin,[5] Henry,[6] Dunn,[7] and others had previously reported cases of chyluria associated with filariæ in which the infection had been contracted within the United States. Opie,[8] in 1901, reported a case of extensive retroperitoneal lymphatic varix in a native of the Dutch West Indies operated upon in this country. From time to time, other more or less isolated cases have been recorded. With the recent influx of American citizens from our tropical islands and the admission of the citizens of other nationalities from the same regions, there has been, however, a great increase in the incidence of filarial diseases in this country.

He then presented a woman who was born in 1895 in British Guiana, where she lived until she was twenty-five years of age. When fourteen years old she had a severe attack of pain in her right thigh and groin associated with swelling, redness, and with abscess formation in the groin. At the same time she had chills and a high temperature. She had frequently repeated attacks of the same character, usually precipitated by dampness or by slight chilling. Each time the swelling of the leg subsided completely.

In 1916, at the age of twenty years, she had an attack affecting the right arm. The arm became swollen and red and three abscesses formed along its inner surface. There was no abscess formation in the axilla. The abscesses of the arm ruptured spontaneously and complete recovery occurred leaving no residual swelling. The right breast was not involved in the inflammatory process.

In 1921 upon the advice of her physician, she moved to the United States. There has been no trouble with the arm or leg since. Soon after her arrival, however, when her second child was ten months old, she noticed for the first

time a lumpy condition in the outer portion of her right breast. These lumps were a little sensitive but gave no real trouble. Two subsequent children were nursed from both breasts. While nursing the first of these the patient had an attack of painful swelling of the right breast which subsided without treatment. Several months later the breast began to have a peculiar shape, and soft areas, apparently containing fluid, were noticed.

In May, 1925, when her last child was fifteen months old, there was a second attack of pain in the breast which caused the patient to seek medical advice. Many diagnoses were made, including cancer, with a recommendation of radical amputation. Following this advice the patient presented herself at the New York Skin and Cancer Hospital for treatment.

Examination.—Both breasts are pendulous. In the right breast, occupying chiefly the outer hemisphere and the areolar region, are large, tortuous, soft, fluctuant areas which more than anything else suggest huge varicose veins. The general course of these tortuous swellings is from the region immediately about the areola and nipple toward the anterior border of the pectoralis major muscle and the axilla. They conform in position and direction to the main

FIG. 7.—Appearance of patient when first examined, showing lymphatic varix of right breast.

FIG. 8.—Appearance of patient two and a half years after coagulation of lymphatic fluid in varix.

lymphatic trunks of the breast. Along the course of these trunks toward the outer zone of the breast some areas of induration are felt. The induration is not the resistant type associated with malignancy. There are no enlarged lymph-nodes in the right axilla nor above the clavicle. There is one small, rather firm node at the anterior border of the pectoralis major muscle. The right arm shows no swelling and appears normal as compared with the left. Two irregular scars are seen on the medial surface of the right arm, one in the epitrochear region, the other about mid-way between the elbow and the axilla. The left breast and axilla appear to be normal.

The unusual character of the lesion and the history of filarial infection suggested the possibility that a relationship might exist. A needle was inserted in one of the fluctuant areas of the breast and about 10 cubic centimetres of clear straw-colored fluid were withdrawn. A microscopic examination of this fluid revealed a number of active embryonic filariæ. One of the living parasites was found in a fresh blood preparation. The urine did not show parasites nor chylous fluid. The blood Wassermann reaction was negative.

With a tentative diagnosis of filarial lymphatic varix, the question of treat-

ment was considered. The disease did not seem to be affecting the patient's general health and amputation of the breast did not seem warranted. Involvement of the breast, however, was so extensive that surgical removal of the varices was impossible without considerable mutilation. Possessing no specific treatment for the condition, it seemed best not to interfere. The patient was apprised of the situation, but it was suggested that she permit further study of the condition. She consented and as opportunity presented itself, various determinations were made.

Fluid content.—Living embryonic forms of filariæ were regularly found in the fluid. The quantity of fluid which could be aspirated varied from 85 to 100 cubic centimetres. When completely emptied, the varices refilled at the rate of about 70 cubic centimetres in twenty-four hours. The fluid itself varied in color from a very delicate pink to a clear straw color. It always contained a few red blood-cells and leucocytes. Its specific gravity, 1.022, was constant. When placed in a test tube, the fluid coagulated rapidly. When left standing, it tended to re-liquefy, leaving a central, soft, fibrinous clot. Its content of urea nitrogen, uric acid, creatinin, glucose, cholesterol, chlorides, calcium and inorganic phosphates was pretty constant. It corresponded closely to that of the blood taken at the same time (see table). When the varicose channels, containing their usual content of lymph, were injected with 1 cubic

TABLE

Comparative Chemistry of Blood from Arm and Fluid from Varix Taken at the Same Time.

	Blood	Blood from Varix
Urea nitrogen	19. mgms. per 100 cc.	16. mgms. per 100 cc.
Uric acid	3.3 mgms. per 100 cc.	3.6 mgms. per 100 cc.
Creatinin	1. mgms. per 100 cc.	0.8 mgms. per 100 cc.
Glucose	118. mgms. per 100 cc.	110. mgms. per 100 cc.
Cholesterol	210. mgms. per 100 cc.	100. mgms. per 100 cc.
Calcium	12.8 mgms. per 100 cc.	12.4 mgms. per 100 cc.
Inorganic phosphates	3.9 mgms. per 100 cc.	3.8 mgms. per 100 cc.
Chlorides (plasma)	6.75 grams per litre	6.82 grams per litre

centimetre of phenolphthalein, it was excreted in the urine at the rate of 16 per cent. to 23 per cent. in two hours, as compared with 57 per cent. excretion following subcutaneous injection in the arm. When the varicose lymphatic channels were completely emptied and then injected with a like amount of normal saline or 5 per cent. glucose solution, an examination of the fluid aspirated twenty-fours later showed a return to the physical and chemical properties of the original lymph. This was accepted as evidence of free emptying and re-filling of the lymphatic varices, although the phenomenon might be explained by diffusion and osmosis.

Microfilariæ.—Attempts were also made from time to time to find a drug which was lethal to the filariæ but which might be safely injected into the varicose lymphatic spaces. When fluid containing the active organisms was placed under the microscope, novocaine in 0.5 per cent. or stronger solution was found to stop their activity almost immediately. Attempts to revive them afterward with warm, normal salt solution were unsuccessful. This suggests the possibility that the beneficial effects of the local injections of sulpharsphenamine with novocaine described by O'Connor[9] in the treatment of recurrent filarial lymphangiitis may have been due, at least in part, to the novocaine. A few injections of 1 per cent. novocaine were made into the dilated lymph-vessels in this patient's breast without apparent result.

Injection of Lipiodol.—In an attempt to demonstrate the distribution of lymph-vessels in the breast, an injection of lipiodol was made in June, 1928.

The quantity which could be introduced at the time was insufficient to distend the varices, so the attempt was given up.

Two days later, the patient developed severe pain and swelling of the right breast with local and general elevation of temperature and chills. The attack subsided without abscess formation. When an examination was made a few days later, it was found that the fluid in the varices had coagulated. There was subsequently a slow resolution of the process with a return of the breast practically to normal. Recent attempts to microscopically demonstrate filariæ in the blood have been unsuccessful.

X-ray Demonstration of Parasites.—Following publication of the work of O'Connor, Golden and Auchincloss[10] on the revelation of calcified filariæ by X-rays, an attempt was made to demonstrate the dead parasites in this patient. In the right arm were found small oblong shadows believed to represent dead, calcareous filariæ.

Discussion of Treatment.—No effective systemic therapy for filariasis has been discovered. Treatment, therefore, is directed toward the relief of local manifestations. Maitland[11] reported good results from the local removal of adult filariæ when they could be located. O'Connor[12] has likewise reported long remissions of filarial lymphangiitis following the injection of sulpharsphenamine with novocaine directly into areas believed to contain adult worms. It is conceivable that patients who have moved to temperate climates and are, therefore, no longer subject to reinfection may be cured by local destruction of the parent filariæ.

In the case of this patient, disappearance of lymphatic varix followed the injection of lipiodol directly into it. This result may have been due to the lipiodol, or to trauma incident to its injection, or there may have been no causal relationship.

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WILM'S MIXED TUMOR OF THE KIDNEY

DR. WM. CRAWFORD WHITE presented a girl, who was born July 22, 1924, and entered the Roosevelt Hospital February 16, 1925 (almost seven months of age). A tumor in the left upper quadrant of the abdomen was first noticed at the age of six weeks. The tumor had slowly enlarged until eight weeks before the operation when the rate of growth had seemed to increase. The baby had otherwise been healthy. She was well nourished and had steadily gained in weight. There were no urinary symptoms and no hæmaturia. Feb-

FIG. 9.—Wilm's mixed tumor of kidney.

ruary 17, 1925, the late Dr. Charles H. Peck did a nephrectomy. "Left rectus incision exposing a tumor of the left kidney. A transverse incision through the left rectus and transverse muscles was added to give more room. The retroperitoneum was incised external to the descending colon until the surface of the tumor was exposed. The tumor had a dark purplish kidney color and was smoothly encapsulated. It was shelled out without difficulty and delivered through the wound. The vascular pedicle and the ureter were ligated, and the wound was closed without drainage."

Gross Description.—The specimen consists of the left kidney and tumor. The tumor has replaced nearly all of the normal kidney tissue which is present only as a shell of varying thickness. The tumor and kidney weigh 350 grams and measure 9 by 9 by 7 centimetres. The tumor is firm and elastic on palpation and ovoid in shape. On section it cuts with slight resistance and discloses a gray, granular surface which appears to be very cellular and is divided into fairly large compartments by delicate strands of fibrous tissue. Palpation of the cut surface shows it to be moderately soft and elastic. At one pole is

an area 4 centimetres in diameter which appears entirely similar to the rest of the tumor but is considerably softer. The tumor has extended down into the kidney pelvis and out to the capsule entirely replacing the normal kidney tissue except for two pyramidal areas at the poles. These pyramids of kidney tissue have their bases at the inner surface of the kidney and measure 1 centimeter in width at the base by 3 centimetres in heighth. On the anterior and posterior surfaces of the kidney the tumor may be seen shining through the capsule which is only 0.25 centimetre thick. The tumor is easily separated from the kidney tissue and capsule and while it extends into the pelvis it is not adherent to it.

Microscopic Description.—The sections show the tumor to be very cellular in composition. The cellular elements seem to be of two distinct types, one of connective tissue origin and the other epithelial orgin, with the connective tissue cells predominating. These connective tissue cells are for the most part round in form, contain large deeply staining nuclei and a scant amount of cytoplasm. The nuclei are granular and occasionally show structures resembling mitotic figures although no true mitoses were observed. Many of this type of cell, however, show transitional forms toward the spindle cell. They have no particular arrangement although there are a few fine strands of fibrous tissue running through the section and dividing it up. These connective tissue cells act as a supporting stroma to the epithelial cells. These cells are arranged in definite alveoli bearing some resemblance to the kidney tubules. The cells are larger than tubule cells, have darker and more granular cytoplasm and larger, more deeply staining nuclei. No mitotic fugures were seen. They vary in shape from cuboidal to columnar and appear one to three deep in the alveoli. Although the connective tissue cells are distinctly the more numerous, the proportion of epithelial cells to connective tissue cells varies in different sections. No muscle cells were seen. The kidney tissue appears normal except that it is greatly compressed and separated from the tumor by a layer of dense fibrous tissue which acts as a capsule for the tumor.

At present the young girl is in excellent health. Of nine cases of Wilm's mixed tumor of the kidney in children, in the records of the Roosevelt Hospital, seven died within the first year, one was alive at the end of four years, when trace of her was lost, and the ninth is the patient here presented. These tumors are especially malignant, with a tendency to recur rapidly and metastasize to the liver and the lungs. The reports in the literature are so discouraging that one might well hesitate to operate because of the apparent futility of the operation. On the other hand, such a result as this patient shows justifies the operation and the expectation of an occasional good result.

Dr. Albert E. Bothe (Philadelphia) said that while the so-called Wilm's tumors are usually tumors of childhood, the majority are removed from patients several years older than the one presented. On account of the wide diversity of pathologic findings, this tumor has been tagged by many names. This, of course, is due to the wide variations in the predominating cellular growth. They are called myxomas, myxosarcomas, sarcomas, adenosarcomas, Wilm's tumors, embryomas, teratomas, and mixed tumors.

When the frequency of Wilm's tumors is compared with all tumors of the kidney in childhood, it bears about the same relation as hypernephroma does to all types of kidney tumors found in the adult.

Owing to the embryonal characteristics of the predominating cells in these tumors, it is natural to assume that they should be radio-sensitive. It is further evident that microscopic sections made from radiated and non-radiated Wilm's tumors show striking differences.

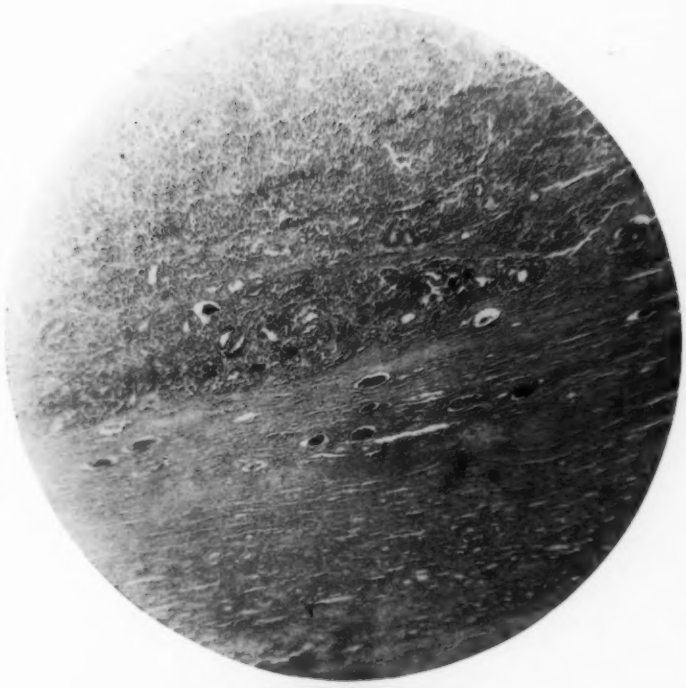

FIG. 10.—Low power: tumor and kidney.

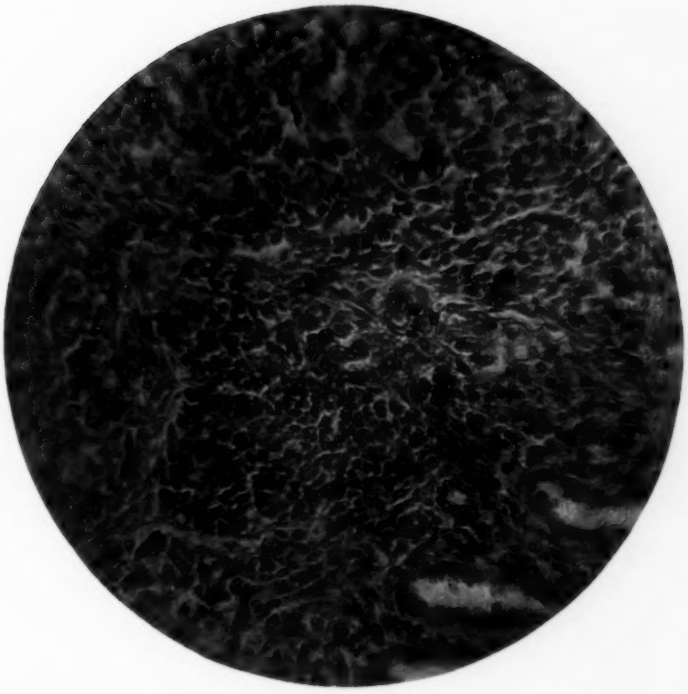

FIG. 11.—High power: tumor.

He had recently seen a girl, eight years of age, who had been operated upon for splenomegaly. When the peritoneum was opened, the mass was found to be attached to the kidney. The abdomen was closed and an extraperitoneal exposure showed a large inoperable tumor. A piece of tissue removed at the time of operation was diagnosed adenocarcinoma of the kidney.

After reviewing the microscopic sections made from tissue removed from this tumor, it was felt that it was representative of a Wilm's tumor and deep X-ray therapy was advised. Since this treatment the tumor has reduced about one-third in size. This reduction in the size of the mass will undoubtedly facilitate subsequent nephrectomy.

He had also studied microscopic sections made from a Wilm's tumor removed after having had a course in deep X-ray therapy. This girl was nine years of age with a tumor mass involving an entire left side of the abdomen. After a course in deep X-ray therapy the mass had reduced about one-half in size. This was followed by transperitoneal nephrectomy by Doctor Randall.

When the sections made from the radiated tumor are compared with the sections made from the nonradiated tumor, the difference is very striking. In the nonradiated tumor there is a predominance of embryonal epithelial cells with very little stroma. The tissue has a very actively growing appearance, while the sections made from the radiated tumor show an extensive fibrous stroma with small islands of embryonal cells embedded in its meshes and considerable evidence of degenerative changes.

It is evident that the findings in the two cases referred to indicate that a preliminary course in deep X-ray therapy should facilitate nephrectomy and reduce the incidence of subsequent extension from manipulation of the tumor mass at the time of nephrectomy.

Dr. Damon Pfeiffer said that many years ago he published a paper on mixed tumor of the kidney which appeared in the last number issued of the Bulletin of the University of Pennsylvania. In assembling the material for this paper he examined the literature on the subject thoroughly and collected many cases, all of which showed that this is a highly malignant condition as a rule, but that now and then a case proves to be benign. Some of the cases are very responsive to treatment so that one need not feel that these tumors are invariably hopeless, and they rate exploration at least.

ACUTE OSTEOMYELITIS OF THE VERTEBRÆ

Dr. John E. Jennings (New York) in presenting a patient, said that acute septic osteomyelitis of the vertebræ, first described clearly by Lannelougue in 1879 and found by him once in 545 cases, has been well studied by Geisel, Donati, Mathieu, Wilensky and others. It may involve either the arch or the body and may occur in any part of the spine. When it involves the arch, subperiosteal abscesses regularly develop which burrow into the surrounding structures or into the spinal canal. When the bodies are involved, pressure on the cord is apparently not so common, but the pleura, pericardium and peritoneum and dorsolumbar muscles are more often involved.

The prognosis is in any event very grave. Mathieu found a mortality of 46 in 100 cases and says that recovery occurred as a rule in the cases in which

the seat of the lesion was superficial (in the posterior arc). One may consider, as fatal up to this time (1924) the cases in which the lesion was situated in the body of the vertebræ.

In most of the cases reported—now in the neighborhood of 120—the disease has been discovered at postmortem or at operation directed toward the drainage of secondary pus collections. He has not discovered a case reported in which early recognition and prompt operation succeeded in limiting the extension of the disease. His personal case, now presented, was a boy, fifteen years of age, who had been discharged from the hospital after a two-months stay during which he had been operated on for acute osteomyelitis of the left humerus and left ileum. Both these foci had been adequately drained and, while still requiring dressings, were progressing satisfactorily. He had been at home ten days when he was suddenly seized with severe pain in the back and mid-abdomen. His temperature rose to 103°, his pulse to 120 and he returned to the hospital within twenty-four hours. When seen on the morning of his second day his spine was rigid, he complained of agonizing pain on motion; the pain was reflected to the abdomen but the muscles of the abdomen were not rigid nor could tenderness be elicited by palpation either in front or back.

X-ray of the spine was negative. The temperature and pulse remained elevated. The pain increased in severity and the rigidity did not diminish. There were no disturbances of sensation or of voluntary motion. On the morning of the fourth day percussion of the spines of the lower dorsal and lumbar vertebræ elicited tenderness which was most marked on striking the first lumbar spine. X-ray was again negative. November 29, 1927, an incision 8 inches long was made parallel to the spines of the lower dorsal and lumbar vertebræ and an inch and a half to the right exposing and removing the transverse processes of the first and second lumbar and last dorsal vertebræ and the head and neck of the twelfth rib. The lateral surfaces of the body of the first lumbar vertebræ were exposed and thin sanious pus exuded from beneath its periosteum. The bone beneath was dark red, with many small abscesses. The entire vertebral body appeared to be involved. Guided by the finger a sharp gouge was pushed through the soft spongy bone to the centre of the body and a cone of infected bone removed. An iodoform gauze strip was laid in this cavity after inspection of the bodies of the adjacent vertebræ which appeared normal and the wound closed. The recovery was uneventful, temperature and pulse reaching normal in a few days. The drained wound closed by granulation and he left the hospital on the forty-fifth day. A culture taken at the time of operation revealed the presence of staphylococcus aureus, as had previous cultures of the other bone lesions.

Dr. A. Bruce Gill (Philadelphia) said that acute osteomyelitis of the spine is often difficult to diagnose in the early stage of the condition. The disease usually presents the same general symptoms as an acute osteomyelitis elsewhere in the body. Local symptoms are pain in the back, tenderness over the diseased portion of the spine, pain on motion of the spine, limitation of motion, and, in time, development of a kyphosis. Abscess forms and points in the appropriate region. An absolute diagnosis may not be made until X-ray examination shows the characteristic lesion of the body of the vertebra. One cannot expect to find this X-ray evidence of disease until at least three weeks have elapsed after its onset. Doctor Jennings' case is exceptional in that he was able to make an absolute diagnosis by exposing the vertebra at the time of operation and finding evidence of lesion in the bone.

BRIEF COMMUNICATIONS

INTERNAL HERNIA FOLLOWING POSTERIOR GASTROENTEROSTOMY*

THE modern operation of posterior gastroenterostomy usually pursues such an uneventful course that any complication is worthy of note.

J. H. (M.E.H. No. 141611), male, aged thirty-five, was first seen by me February 21, 1930. He had been operated upon six months before by another surgeon, the appendix and gall-bladder being removed. Following this operation he was well for about four months when he developed pain in the epigastrium, sometimes accompanied by vomiting, and not relieved by medicine or food, practically continuous for the preceding six weeks. X-ray examination disclosed an active ulcer on the lesser curvature about 3 inches from the pylorus.

February 27, 1930, I resected the ulcer-bearing area. There were extensive adhesions making the resection difficult. He did very well for eight months when he again developed distress. For a while under dietic measures he improved; then in spite of these measures strictly carried out the pain became unbearable. X-ray examination demonstrated a new ulcer on the lesser curvature at or near the line of resection.

A laparotomy, done December 27, 1930, disclosed an almost overwhelming number of adhesions about the pylorus and site of the resection. As further stomach resection was impracticable, a posterior gastroenterostomy was done; even this was difficult on account of the fixation of the stomach. The loops of the vessels in the mesocolon were small so that it was only with difficulty and after ligating some of the branch vessels that a sufficient amount of stomach could be brought through to allow of gastroenterostomy. An extremely short loop was used, just sufficient to allow of placing the clamps with a small strip of gauze below. Iso-peristaltic posterior gastroenterostomy was performed in the usual manner, the mesocolon being sutured to the stomach as the final step after withdrawal of the clamps; the small piece of gauze was withdrawn from left to right and a stitch placed joining the mesocolon to the stomach in the mid-line of the gastroenterostomy posteriorly. The gastroenterostomy functioned immediately, its leading-away loop descending toward the pelvis and filling out well.

For ten days the course was uneventful except for a spasmodic cough. The Fowler position was used. On the tenth day the patient became nauseated and vomited repeatedly. His stomach was lavaged; vomiting recurred and operation was decided upon. The abdomen was opened January 8, 1931, through a left rectus incision, the previous incisions having been through the right rectus. It was at once noted that the stomach was dilated and that the visible portion of the small intestine was collapsed. The adhesions to the right of the incision were too dense to allow of dissection. Immediately under the present incision, however, the field was quite clear and it was possible to easily draw up the transverse colon. The finger could be readily introduced from the stomach side into the gastroenterostomy opening. It was found that a loop of the jejunum had entered from right to left the small opening between the mesocolon and the first portion of the jejunum proximal to the gastroenterostomy. This opening at the time of the preceding operation was only sufficient to allow of placing the clamps and a thin strip of gauze. The operation had been done in the same manner as some two hundred previous posterior gastroenterostomies which I had performed, and in which this complication had not occurred. The amount of jejunum which had herniated through the opening was

* Read before the Brooklyn Surgical Society, March 5, 1931.

a foot or more, involving the jejunum right up to the gastroenterostomy so that there was no way in which the proximal jejunum could empty into the distal jejunum. There was no strangulation, the jejunum looked quite normal when pulled out of the opening, but through its kinking it had completely obstructed the jejunum distal to the gastroenterostomy. Immediately upon its release the jejunum filled and the gastroenterostomy again functioned. There were no adhesions; healing seemed perfect. I considered whether to close this small opening with a stitch but decided against it as it seemed almost inaccessible. Another reason for not closing it was the rarity of this particular complication. I had in mind that it might have been caused by the spasmodic cough from which this patient had suffered. I had observed this cough and it involved a pumping action of the abdomen, a drawing in. I considered this was the possible cause of the internal hernia.

For three days the patient pursued an uneventful course; first he was put upon a lacto-farinaceous diet, and then a soft diet, and took his feedings well. On the seventh day a report came to me he was nauseated. I had him turned upon his right side, thinking the hernia might have recurred and a change of position might influence it. Within a few minutes of being turned on his right side he vomited thirty ounces of dark bile-stained duodenal contents. I then ordered him placed on his left side and feeding continued. On the ninth day he twice vomited ½ ounce of thin greenish-yellow fluid, and on the eighteenth day 16 ounces since which time there has been no recurrence of his nausea and vomiting.

It is now two months since his last operation. He has a healed wound and is without symptoms. He is, of course, receiving dietetic treatment for his ulcer.

Comment.—Moschcowitz and Wilensky in 1915 collected eight cases of this nature, Ashhurst in 1902 added a case, and Bryan in 1920 added another case. An analysis of these cases shows that three (Peterson's first case, Ashhurst's case* and W. J. Mayo's case) were anterior gastroenterostomies, that one (Streudel's) was posterior by Murphy button, that one (Gordon's) does not give sufficient detail, and that in five instances (Moschcowitz and Wilensky, Peterson's second case, Gray, Barker and Bryan) the complication occurred after a posterior short-loop or no-loop operation by suture, so that the present case is the sixth to be recorded occurring after a so-called no-loop operation. Of these six cases five (Moschcowitz and Wilensky, Gray, Barker, Bryan [twice] and R. S. Fowler) were reoperated and one (Peterson) was demonstrated at autopsy. Of the reoperated cases four recovered (Gray, Barker, Bryan and R. S. Fowler) and one (Moschcowitz and Wilensky) died.

It is, of course, quite understandable how a long-loop posterior gastroenterostomy could be followed by internal hernia. The rarity, however, of this form of hernia occurring after a so-called no-loop operation is significant of other factors than the mere mechanics of the operation being responsible. I think in the present case it was the peculiar pumping action of the abdomen used by the patient in controlling his cough.

The condition is apparently due to the fact that rather too long a loop is left proximal to the anastomosis. When a clamp is applied to the left-hand extremity it should not be more than 1 inch from the flexure. The proximal loop will then lie close up to the mesocolon to which it may shortly become

* Personal communication.

adherent. If a 2- or 2½-inch loop is left adhesions are less likely to form and a hernia may result. In my own case the opening through which the hernia occurred was only sufficiently large to allow of the emergence of the tips of the gastroenterostomy clamps and a very thin piece of gauze, a shaken-out stick sponge.

To the student of gastroenterostomy there will, of course, occur various measures by which this very rare complication can be avoided or its recurrence prevented. They range from closure of the opening by a stitch or two to the suturing of the afferent portion of the jejunum to the stomach, or to the mesocolon as was done in years gone by in anterior and posterior gastroenterostomy with long loops to avoid kinking.

Moschcowitz and Wilensky advise that the afferent loop should be sutured to the under layer of the transverse mesocolon. Bryan (case particularly interesting in that it recurred) did an enterojejunostomy together with a suturing of the leading-away loop to the abdominal wall at the second operation.

Walton suggests that if there be any doubt as to the presence of such an opening the afferent loop should be sutured to the under leaf of the mesocolon.

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LIFE-CYCLE OF A GASTRIC ULCER

ALTERNATING HEALING AND RECURRING

IT IS a well-known fact that a gastric ulcer of considerable size can disappear spontaneously without leaving a trace of a lesion on the X-ray film. Such cases have been reported by Ohnell[1] (37 cases), Diamond[2] (12 cases), and others. This phenomenon is usually called: Life-cycle. No recurrence was noted in any of these cases, though some were checked up by repeated X-ray examinations extending over a number of years. They really did not represent true life-cycles. For a cycle should really mean appearance of an ulcer and its disappearance at different intervals.

I had occasion to study a case of gastric ulcer with a true life-cycle over a period of eight years. A large gastric ulcer, present in 1922, had prac-

tically disappeared in 1924, reappeared in 1927, only to disappear a few months later. A third cycle was demonstrated on the X-ray films taken in 1930. The rarity of this röntgenographic observation justifies a short presentation of the case.

FIG. 1.—Large gastric ulcer, situated near the cardia. September 26, 1922.

FIG. 2.—Ulcer markedly diminished in size; note incisura opposite ulcer. September 25, 1923.

No. 224674, J. D., male, forty-seven years old, was admitted to the surgical service of Mount Sinai Hospital November 11, 1922, and discharged December 4, 1922. He presented a history of upper abdominal pains, extending over a period of a few months. The pains occurred one to two hours after a meal. X-ray examination of the gastro-

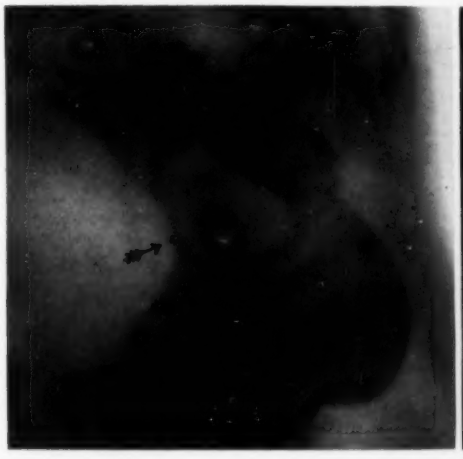

FIG. 3.—Ulcer has practically disappeared. No incisura opposite ulcer. June 18, 1924.

FIG. 4.—Small pin-point elevation on the lesser curvature shows location of former large crater-ulcer. November 18, 1925.

intestinal tract showed a large projection on the lesser curvature of the stomach, just below the cardia. (Fig. 1.) The röntgenologist stated that, in view of its size, this penetration was due to a carcinoma and not an ulcer. The physical examination was essentially negative. Gastric analysis showed: free hydrochloric acid 30, total acidity 55.

Exploratory laparotomy revealed a firm irregular mass with a large crater on the lesser curvature near the cardia. A large number of glands were felt near the lesser curvature. The mass was considered malignant. A radical removal seemed impossible on account of its size and location. It would have necessitated a total gastrectomy. A

FIG. 5.—Recurrence of gastric ulcer; large niche, hour-glass stomach. February 18, 1927.

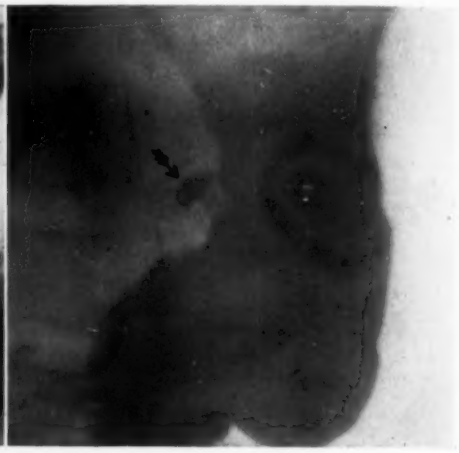

FIG. 6.—Niche much smaller; no hour-glass formation. March 11, 1927.

gland was removed from the omentum and the abdomen was closed in layers. Microscopic examination of the gland failed to show evidence of malignancy.

Post-operative diagnosis.—Inoperable carcinoma of the stomach.

The error of this diagnosis became evident when the patient began to improve in health following the exploratory laparotomy. An X-ray examination taken in 1923

FIG. 7.—Niche has disappeared. Hour-glass formation. April 11, 1927.

FIG. 8.—Stomach appears practically normal. November 7, 1927.

showed that the ulcer had markedly diminished in size; the stomach showed marked hour-glass formation. (Fig. 2.) A picture taken in 1924 showed that the ulcer had practically disappeared; no incisura was visible opposite the ulcer. (Fig. 3.) In 1925 only a small pin-point elevation was visible at the site of the former location of the large crater-ulcer (Fig. 4.)

FIG. 9.—Recurrence of ulcer. Hour-glass stomach. March 4, 1930.

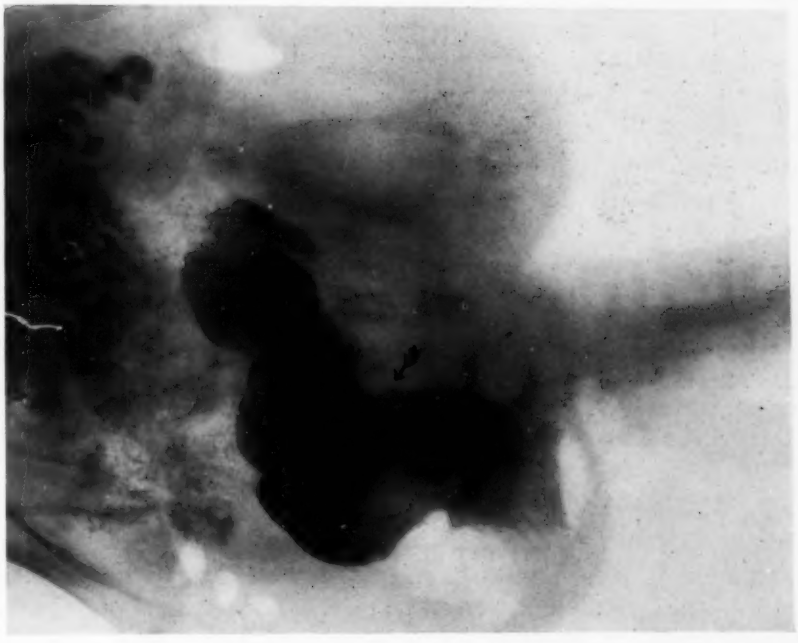

FIG. 10.—Ulcer very small. No hour-glass formation. May 23, 1930.

His symptoms recurred in February, 1927, and a large niche with hour-glass formation was demonstrated on the film. (Fig. 5.) During the next two months the niche decreased in size gradually. (Figs. 6 and 7.) The stomach presented a practically normal appearance in November, 1927. (Fig. 8.) By this time his symptoms had subsided and he felt perfectly well. The third recurrence was demonstrated by röntgenography in March, 1930. (Fig. 9.) Two months later the ulcer was very small and the hour-glass formation had disappeared again. (Fig. 10.)

It is very important to point out that this patient received neither surgical nor medical treatment.

If, at the time of the exploratory laparotomy, I had performed a gastroenterostomy—a method still popular among surgeons in spite of its inefficacy—the disappearance of the niche would have been attributed to this operative method.

If the patient had received careful medical treatment (rest in bed, Lenhartz or Sippy diet, *etc.*), the result might have been ascribed to good effects of internal therapy. We often read in reports about this group of cases that the niche disappeared following medical treatment, implying that the treatment cured the ulcer. However, in this patient the crater-ulcer disappeared spontaneously three times without any medical régime. I have often wondered whether ulcers are really influenced by medical treatment.

I do not think that any of the disappearances of this ulcer, as demonstrated on the X-ray films, represented a real cure, but rather a diminution in size of the ulcer which was so marked as to reveal practically a normal stomach on three X-ray examinations. It is most likely that a very small inflammatory area still persisted in the intervals. Whenever re-infection occurred, the cycle started all over again.

An important lesson to be learned from this case is that even a disappearance of a crater-ulcer with normal X-ray findings does not necessarily mean a permanent cure. The ulcer may reappear at any time and may then undergo malignant degeneration.

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BIPARTITE PATELLA

WHILE bipartite patella is an unusual developmental anomaly which has been reported by various writers, a case is reported with a review of all the literature, in order that there should be enough familiarity with this condition so that it will not be reported erroneously as a fracture, as has been done with most of the cases in the past.

The facts brought out in this article have all been noted by other observers. However, because of the economic importance of a correct diagnosis and the frequency with which this condition is confused with a fracture, a reiteration of some of the important details should be helpful.

CASE REPORT.—S. E., a white male, aged thirty-one, was seen on the evening of November 15, 1930, complaining of severe pain in the left knee. The day before, he injured the inner aspect of his knee against the side of a desk. Following that injury he had slight pain in the knee, but the pain gradually became very severe so that he could not move his leg. He denied any previous injury to the knee and stated positively that he had never had any trouble prior to this injury.

When first seen he was holding his left knee flexed. Both knees showed a bony prominence of the outer and upper aspects of each patella. He stated that these bony prominences had been present from birth. The left knee was swollen only slightly with

FIG. 1.—Showing the smaller patella at the outer and upper quadrant of the main patella.

practically no fluid increase. There was extreme localized tenderness over the internal lateral ligament and over the internal semilunar cartilage. AGE—180 degrees, AGF—75 degrees.

A diagnosis of internal derangement of the left knee-joint was made. A plaster bandage was applied to the knee in an extended position. A Röntgen-ray was ordered on both knees. Through a mistake, plates were taken only on the injured knee and the röntgenologist reported it as a fracture of the patella. Knowing that the history and physical findings were not those of a fractured patella, the patient was sent back for films on his right knee. A similar condition was found on this side also.

The patient was given the usual treatment for an internal derangement of the knee and was discharged seven weeks after the injury as cured. He has had no further trouble from that knee.

The patella is generally considered as a sesamoid bone. It is ossified from a single centre, which usually makes its appearance in the second or third

year, but may be delayed until the sixth year. Occasionally, the bone is developed by two centres placed side by side. Ossification is completed about the age of puberty. Even when it arises from two centres of ossification the patella is usually one single bone, but in case fusion fails to occur, it gives rise to a bipartite patella.

Wenzel Grüber, of Petrograd, described the first case in 1883 and gave to the condition the name of "Patella Bipartite." Grüber's observations were the same as subsequent writers on this condition. He described two patellas resembling ordinary patellas, presenting at their superior external angle a deep notch in the form of a half-moon or crescent. It is in this excavation that is lodged the small fragment which is the accessory patella.

Other cases have been reported by various English and French writers, and all cases of this anomaly generally present the same Röntgen-ray appear-

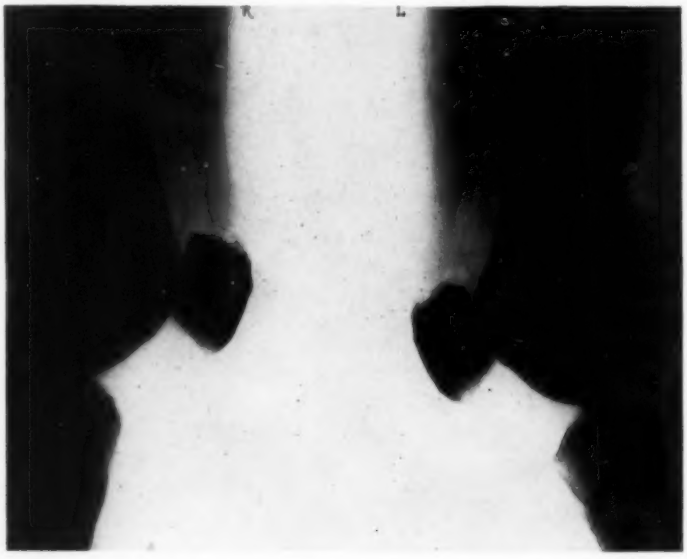

FIG. 2.—Showing the small fragment at the base of the patella.

ance. The anterior-posterior view (Fig. 1) is the most valuable and here we see that the outer and upper portion of the patella is the part which is always involved. The contour of the patella is generally not distorted. There is a definite space between the adjacent surfaces of these fragments. The separated fragment is much smaller than the main patella. Occasionally the small fragment may be divided into two parts. The space separating the main patella from the smaller bone is always uniform throughout its entire length. Fractures generally show serrated edges. In the lateral view (Fig. 2), we see a small fragment of bone just above the base of the patella. One may be misled in diagnosing it as a fracture occurring through indirect violence by pull of the quadriceps tendon. But in such cases the bone is usually snapped transversely at about the junction of its lower and middle third. Fortunately most of these anomalies are bilateral.

Following Grüber's description of this condition in 1883, Joachimstal described this anomaly in 1902 while Kohler mentioned this condition in his book. Moreau reported three cases and Reinbold four similar cases. Mouchet reported one case with observations done on the cadaver. In an intensive study of the anomalies of the patella resulting from observations made on the cadaver, Todd and McCally also reported this condition. Fournier, in 1923, used it as the subject for his Doctor's thesis. Adams and Leonard, in an excellent article, reported a series of six cases during a period of five years, four being diagnosed erroneously as fractures of the patella. Five of their cases were bilateral. George and Leonard reported a case in 1925 and stated that in the presence of a suspicious bone abnormality in the right upper quadrant of one patella, the other should always be röntgenographed for a possible congenital anomaly.

CONCLUSIONS

1. Bipartite patella is a congenital anomaly which may be mistaken for a fracture.

2. The recognition of this condition is important for economic reasons.

3. The history and physical findings in these cases are rarely those of fractured patella.

4. The location of this anomaly is always in the upper and outer quadrant of the patella and it is rare that one finds a fracture there.

5. The Röntgen-ray is the only means by which one can make a definite diagnosis, as this anomaly is nearly always bilateral.

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THE USE OF THE ELECTRIC BREAST PUMP AS A PROPHYLACTIC MEASURE AGAINST SECRETORY STAGNATION IN THE BREAST AND POSSIBLY MAMMARY CANCER

IN A previous publication (Adair, F. E., and Bagg, H., Breast Stasis as the Cause of Mammary Cancer, International Clinics, 1925, vol. iv, p. 19) the conclusion was drawn that mammary cancer is in large part due to the resultant irritation that follows the retention of stagnating secretions within the duct system of the breast. Of 200 patients with mammary cancer selected consecutively from the breast clinic of the Memorial Hospital, 183 had at one or more times a well-marked secretory stasis in the breast. Secretory stasis may be due to any one or to a combination of the following conditions; malfunction or incomplete function due to failure to nurse the child, to miscarriages and incomplete lactation, to a rapid succession of childbirths without normal intervals for proper drainage by suckling, to the non-establishment of mammary function and the consequent accumulation of stagnant cell detritus within the small ducts, to stenosis at the nipple such as the angulation of the ducts accompanying inverted nipples, or to stenosis at any point along the drainage system.

A chemical irritation and inflammation is produced within the ducts and in the periductal tissues by the following causes: (*a*) The milk is retained within the breast by artificial means; a dissolution of the milk follows into its chemical components; some of these end-products are lactic acid and butyric acid—both are marked irritants. One of us (Adair) has demonstrated by chemical analysis the presence of lactic acid in stagnant human milk. Experimental cancer in lower animals has been produced by the application of lactic acid; butyric acid is a much stronger irritant. The tissue reactions to these irritants in and about the ducts are manifested by hyperplasia of the ductal epithelium and mononuclear infiltration of the stroma. (*b*) During pregnancy there is a greatly increased production of new ductal epithelium and new acini in order to produce milk in sufficient quantity. By the artificial cessation of lactation, this bulk of new tissue is locked within the breast to undergo sudden atrophy, desquamation and degeneration. We believe this abrupt change affords another source of chemical irritation within the breast.

The relative frequency of cancer in the upper outer quadrant, commonly called the "tail of the breast," has been attributed to the faulty drainage incident to its greater distance from the nipple. Ewing likewise has been impressed with the evidence of stagnation in the ducts leading from the segment

involved by cancer. At the Memorial Hospital, Bagg performed unilateral ligations of the mammary ducts in a number of mice, which were then allowed to become pregnant and suckle their young. In a significant number of mice, cancer developed in the breast corresponding to the ligated ducts.

Some varieties of chronic mastitis are associated with secretory stasis in the breast; in a certain number of these cases, precarcinomatous changes and even cancer may develop in the dilated ducts. The prevention of secretory stasis in the breast or its relief when present is, we believe, one method of avoiding mammary cancer. This prophylactic measure is attempted by the careful use of local moist heat, by gentle massage consisting of a stroking motion from periphery to nipple, a soft rolling of the nipple between the thumb and index finger in order to dislodge the desiccated plugs in the terminal ducts of the nipple, and by the use of the electric breast pump. Cancer must be most carefully excluded before resorting to these procedures.

Many years following pregnancy we have been able to express material from the breast by this gentle manœuvre together with the breast pump. This material may be either a creamy paste or a thick semi-fluid mucin. The bulb hand pump has been used to empty these breasts for a number of years, but during the last year we have been more impressed by the use of the electric breast pump.

The Abt electric breast pump consists of a reciprocating pump driven by an electric motor. The reciprocating device permits the fairly rapid alternation of suction with pressure in order to massage the nipples as does the nursing infant. It may be used to advantage in the treatment of those conditions previously mentioned, which predispose in time to the development of mammary cancer, *e.g.*, the engorgement of the breasts after miscarriages or premature labors. The breast pump successfully removes the comedo-like casts of cell detritus found in the type of chronic mastitis with enormous dilated ducts, the so-called "varicocele" tumor of the breast. It affords good drainage for other varieties of chronic mastitis which discharge from the nipple. It secures sufficient exudate and content of cells to permit satisfactory microscopic examinations of the smears. When transillumination of the breast precedes and follows the use of the breast pump in certain cases of bleeding nipple, the intraductal papilloma, which may be responsible for the sanguineous discharge, can be definitely localized. A significant number of multiparous women with one normal and one inverted nipple develop cancer in the breast with the inverted nipple, presumably due, as indicated by the nursing history, to improper lactation and insufficient drainage by suckling. The electric breast pump not only milks such breasts but aids in the extrusion of the nipple. We consider the electric breast pump to be a valuable instrument in any breast tumor clinic.

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SIMPLE ENTEROSTOMY TECHNIC

As THE value of enterostomy is more appreciated and applied in abdominal surgery, the demand for a satisfactory plan of operation is correspondingly increased.

The procedures now in vogue have certain deficiences that, I believe, are overcome by the operation herein proposed.

The method now most generally used often fails, because its execution violates a fundamental mechanical principle, namely, if two substances of unequal density are bound together and subjected to stress or strain, the one of less density will yield under the tension, thereby destroying the union. In case of a damaged intestine, the most careful introduction of sutures will produce perforation and leakage.

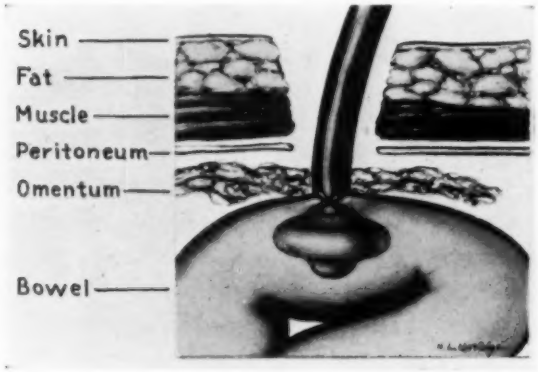

FIG. 1.—Catheter loop of bowel which is distended.

The plan I wish to propose is the following: Thread a Pezzar catheter on a stylette such as urologists use for introduction into the bladder. Insert the catheter thus equipped through a small opening in the intestinal wall. When the stylette is removed the expansion of the distal end of the catheter is sufficient to hold it in the lumen of the bowel. If the bowel has not undergone disintegration, one or two layers of Lembert sutures through the bowel around but not through the tube add to its security. The stem of the catheter is then passed through a small hole in the omentum and brought out at the lower angle of the incision.

When convalescene is established, the stem of the catheter is drawn out and cut as close as possible to the abdominal wall. The intra-intestinal segment is allowed to drop into the bowel to be taken care of by the natural processes of evacuation.

The accompanying illustration will serve to indicate the details of the operation (Fig. 1).

A tube thus placed acts as a means of drainage for the bowel and permits the easy escape of gas in the event of distension. It can also be utilized as a facility for irrigation and the administration of food, medication and fluids. The intra-intestinal portion in the experience of the author has always been promptly evacuated with the fæces and has never caused any anxiety or uneasiness.

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THE TREATMENT OF POST-OPERATIVE "GAS PAINS"

THE very common and often very distressing post-operative "gas pains" are frequently given scant consideration by the surgeon. It is true that the average patient with such pain will usually recover within a few days, but many times not until hours of suffering have been experienced.

The usual treatments with morphine, enemas, rectal tube and heat applied to the abdomen are often beneficial, but frequently fail to give rapid and satisfactory relief. A more specific treatment is desirable, and I believe is available in a hypertonic solution of sodium chloride.

In a recent series of fifteen patients with post-operative abdominal pain, we have administered 10 per cent. hypertonic salt solution intravenously in a dosage of 20 cubic centimeters. The solution is given slowly with a 20 cubic centimeter syringe with a small needle over a period of four or five minutes. These patients did not have any evidence of intestinal obstruction or peritonitis. In each case the time of onset of pain, presence of visible distention, audible peristalsis by stethoscope, eructation of gas, passing of flatus, and the patient's own statement in regard to results obtained were noted.

The time of the onset of pain has usually been between twelve and thirty-six hours after the operation. Peristalsis could be heard with the stethoscope and an increase in sounds was noted after medication. Some distention was usually visible. In two-thirds of the cases there was eructation of gas and passage of flatus within a few minutes to an hour after the salt was given. In only one instance did a patient state that no relief was obtained by the treatment. Some patients noted relief before the intravenous injection was completed. In some cases a second or a third injection was necessary before complete relief was obtained. If "gas pains" recurred the following day the treatment was repeated.

The relief given these patients is probably due to the passing of gas by bowel or at least the shifting of gas from the small to the large intestine. On one or two occasions a patient remarked that no gas was expelled, but something seemed to change within the abdomen, bringing relief.

Since it has been definitely proven that a hypertonic solution of sodium chloride will increase peristalsis and raise the tone of the gut muscle, it is reasonable to believe that the relief obtained by giving such a solution is due to an expulsion of gas from a distended small intestine.

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BOOK REVIEWS

NOGUCHI. By GUSTAV ECKSTEIN. 8 vo.; cloth; pp. 419. Harper & Bros., New York, 1931.

For more than twenty-five years, the presence in the laboratories of America of an ambitious, enthusiastic, indefatigable, far-seeing laborer from Japan, was a source of inspiration and accomplishment. His death, on the African coast in 1928 from yellow fever, the origin of which he was striving to solve, tragically ended his devoted life, a life apparently brief but long enough to have added most important facts to the knowledge of the causes of disease and to have enrolled indelibly on the scroll of fame the name of Noguchi.

The book that is before us has been written, evidently, by one who was in full sympathy with the peculiar force and intense energy which characterized the subject of his pen. The book itself is more than a biography. It has all the characteristics of a novel. Noguchi himself is made to live before the reader as the portrayal of his life continues. The record follows him from his birth in a peasant's cottage in Japan in 1876, the early development of an ambition for a medical career backed by a peculiar genius for accomplishment, through the village schools of his birthplace. Driven by this ambition, he makes friends that carry him through to the medical schools in Tokio. Arrived thus far, he yearns for a wider field on the other side of the Pacific. Here he arrives, friendless and without money, to begin a career that staggers imagination. In 1900, his twenty-fifth year, he sailed for America. Beckoned on by a lure which had its foundation only in hope, he beats his way to Philadelphia where he attracts the notice of Simon Flexner and the patronage of Weir Mitchell. Finally he finds himself possessed of the resources of the Rockefeller Institute.

Not only in the country of his adoption does he pursue his labors, but into Central and South America and into Africa he extends his researches. Such problems as serpent venoms, syphilis, Rocky Mountain spotted fever, infectious jaundice and yellow fever in turn yield their secrets to his cultures and serums and to his microscope. When he died, he left the world richer that he had lived.

In his work he ever showed all the characteristics of genius—genius which has as it elements three chief components: a thirst for labor, a quickness to appreciate a cause for labor, and an ability to carry on the labor until its object is accomplished. As his biographer says, "Noguchi had the characteristics of genius; colossal energy which gave him the ability to work for weeks almost without sleep when the fire of accomplishment burned in his brain; a tremendous passion for research."

LEWIS S. PILCHER.

TRAUMATOTHERAPY. By JOHN J. MOORHEAD, M.D. 8 vo.; cloth; pp. 559. W. B. Saunders, Philadelphia, 1931.

With the rapidly increasing number of accidents due to the more general use of the automobile, and the industrial injuries resulting from the multiplying employment of mechanical devices, greater and more immediate surgical knowledge is required of the modern physician. This is particularly essential in the treatment given in the accident ward where such cases are, for the most part, usually taken.

The author has attempted to detail the technic of the immediate treatment to be afforded all the usual and many of the more unusual effects of trauma and to show their actual management in this volume which consists of twenty-six chapters covering the various classes of injury as wounds, dislocations, fractures, amputations, use of splints, antiseptics, anæsthesia, post-traumatic disabilities, medico-legal aspects, general standardized procedures in first aid treatment and application of the Carrel-Dakin technic.

The text and illustrations give to the reader many ingenious methods to circumvent certain mechanical difficulties. Naturally, attempting to cover such a vast field, much detail must necessarily have been omitted. Still the procedure to be primarily undertaken is usually well indicated and, if followed, will undoubtedly greatly shorten the time of disability and minimize the ultimate deformity.

Nothing better or more concise could be afforded one for ready reference. The book should be available in all accident reception clinics or wherever first aid dressing is likely to be called for.

JAMES T. PILCHER.

CONGENITAL CLUB FOOT. By E. P. BROCKMAN, M.D. 8 vo.; cloth; pp. 110; many illustrations. William Wood and Co., New York, 1930.

This very readable book presents an interesting outline of the history of the treatment of congenital club foot in three periods: First from Hippocrates to Little in 1839, when he introduced the subcutaneous tenotomies; second period up to the publication in 1898 of "Deformities of the Foot" by Walsham and Hughes; and the third period to the present day. It is an interesting description of the advances made through the ages, at first very slowly, with long lapses with no increase of knowledge in the understanding of the real condition. The nature of the deformity is next taken up, dividing it into three types, first, the common form of talipes equino varus, second, that associated with other malformations—the arthrogryphosis or congenital contractures—third, the rare type of talipes seen with absence of a part or the whole of the tibia and sometimes absence of toes.

The normal anatomy of the foot is carefully described, especially the muscles and joints, and the normal motions of the tarsus as produced by the different muscles. Particular stress is laid on the subastragalar and astragalo-scaphoid articulation where the principal deformity of the club foot

takes place. A chapter on the pathological anatomy treats of the common variety and the second and third types, and is fully illustrated with drawings, photographs and X-rays. The articulation of the scaphoid with the astragalus where the greatest fault lies is much emphasized by the author in this and the preceding chapter as well as in the discussion of the principles of treatment.

The various theories of etiology are presented and reasons given against the mechanical theory of pressure which has been largely held responsible. The author believes it a failure of normal development, but cause unknown.

The treatment outlined is very thorough in detail and carries out the ideas stressed in the chapter on pathological anatomy—namely the deformity which takes place at the astragaloid joints. But the writer does not employ as a rule plaster-of-Paris to hold the foot in corrected position. He uses considerable manipulation two or three times a week and depends upon adhesive plaster to maintain the correction gained. Failures and relapses are acknowledged in a larger percentage of cases than are seen in this country where plaster-of-Paris is pretty generally used. Possibly his method would be preferable in the milder deformities to the American way.

The book is abundantly illustrated, contains many good suggestions and is very readable.

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